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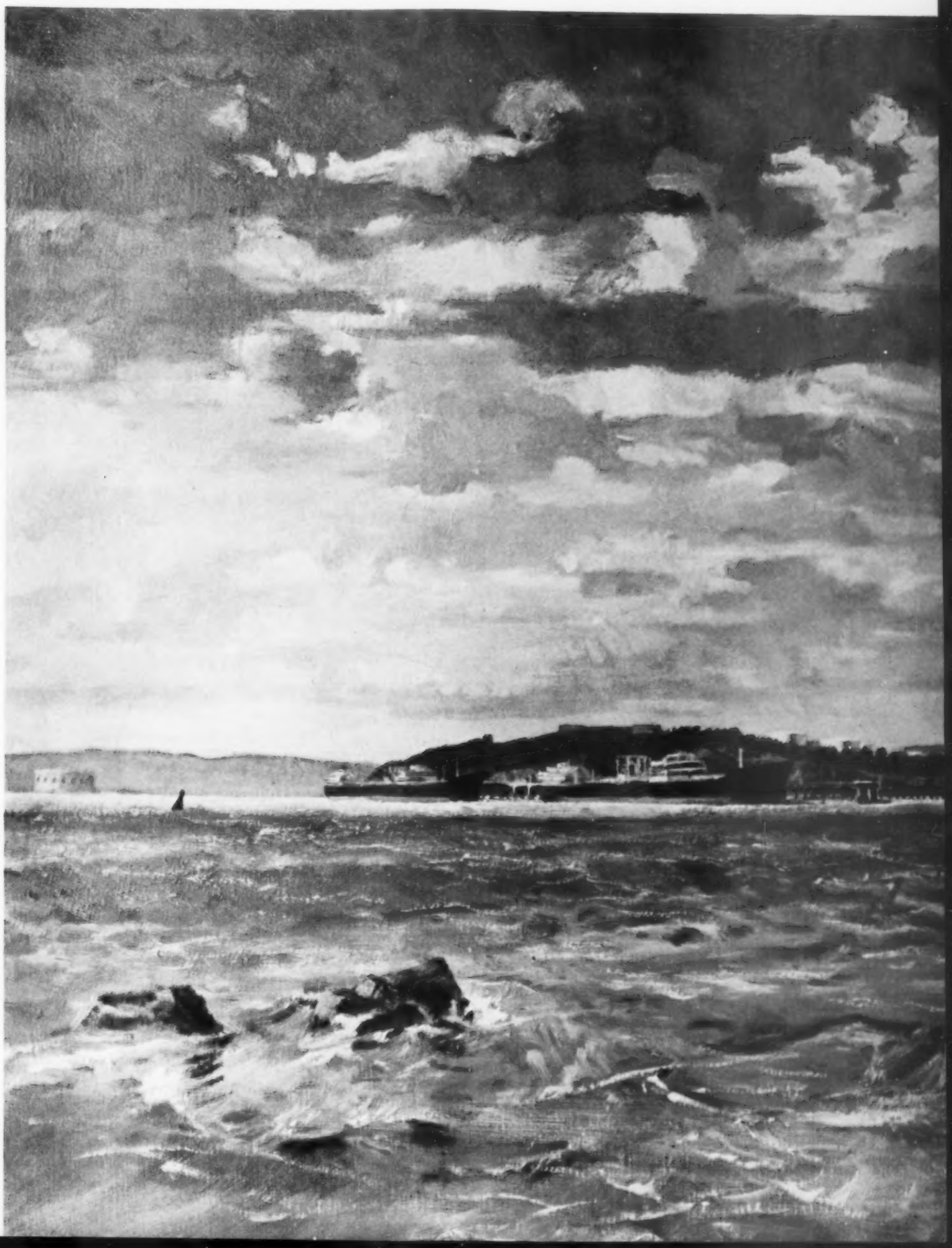

OCTOBER, 1961

table of contents page 3

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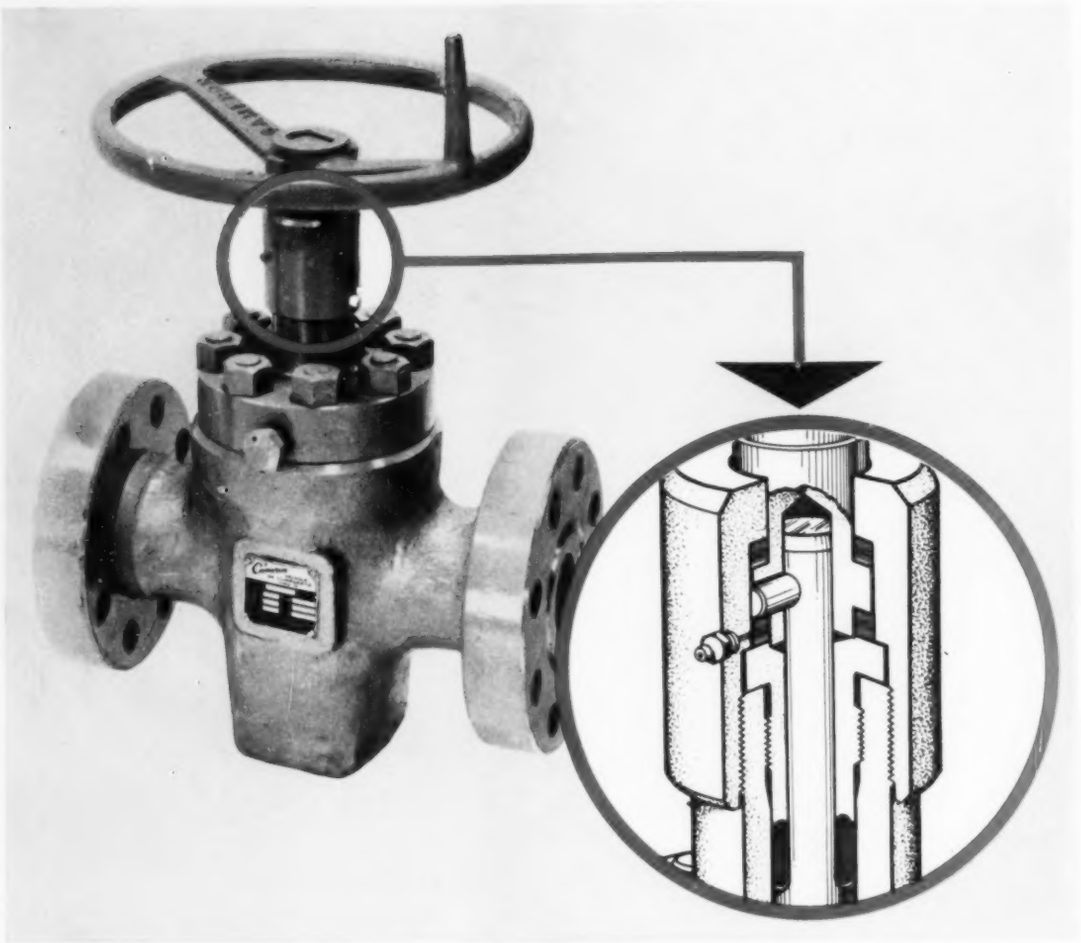

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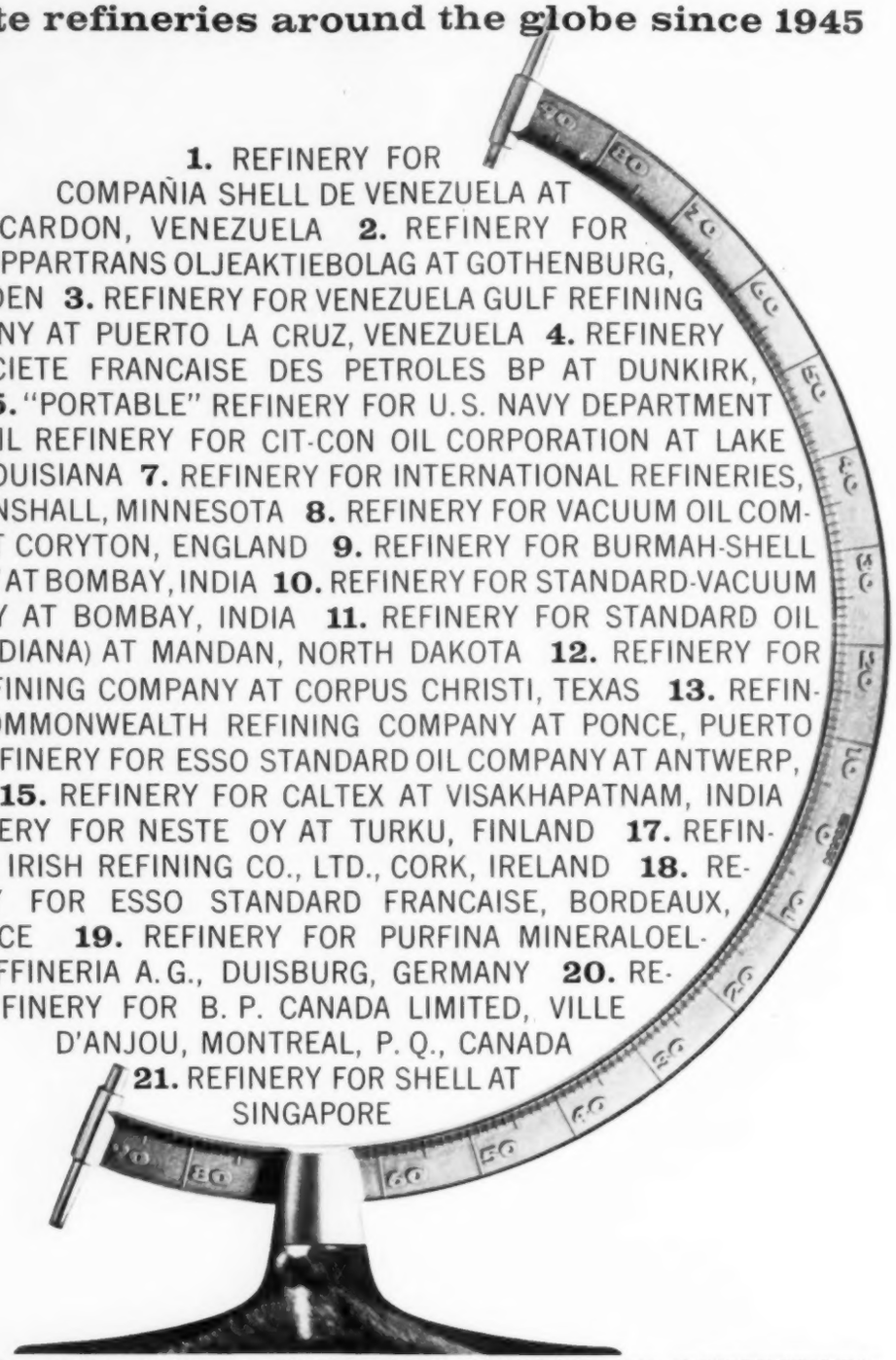

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World Petroleum

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

CONTENTS

4 Washington Pipeline, *by Joseph B. Huttlinger*
10 London Letter, *by Cecil W. Wood*
16 Canadian Notes
35 Editorial—Better Harbor Facilities Needed . . . now!
36 World Tanker Fleet Growth Rate Continues to Decline
41 New UK Terminal at Angle Bay designed for 100,000-Tonners
42 The Case for the Bridge Aft Tanker
44 New Sea Terminal in Hawaii Can Handle Tankers of All Sizes
46 Jersey Standard Conducts World-wide Marine Research
48 Winter No Longer Stops Pipe Line Construction
54 Tanker Corrosion Prevention Progress
56 New Technology Boosts Markets for Petrochemical Toluene, *by Peter W. Sherwood*
64 Processing Review, *by William C. Uhl*
78 Oil Company Staff Changes
82 International News and Notes
86 Advertisers' Index

THIS MONTH'S COVER

A familiar sight along England's coast is the busy tanker fleet. This artist's version is reproduced here through courtesy of the Esso Magazine in London.

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by Joseph B. Huttlinger

Names Jet Service Firms

The Department of Justice has accused seven corporations connected with the oil-well service business of conspiring to restrain trade by controlling patents on the jet process for perforating oil-well shafts.

The DJ named six oil-well servicing firms, as follows: Borg-Warner Corp., Chicago; Dresser Industries Inc., of Dallas; Halliburton Co., Duncan, Okla.; McCullough Tool Co., Los Angeles; Pan Geo Atlas Corp., Houston; Schlumberger Well Surveying Corp., Houston.

DJ also named Jet Research Center Inc., of Arlington, Texas.

In the civil antitrust action, DJ said the firms along with co-conspirators do more than 95% of the $26 million a year business involving the jet process to allow oil to enter the wells.

The DJ action, filed in US District Court at Houston, added that other oil-well servicers took part in the conspiracy, in violation of the Sherman anti-trust act. These firms, it said, who were not named, pay more than $84 million a year in patent license fees to the eight defendants.

The jet process, now used in 65% of oil-well perforation, has gradually supplanted the older bullet process, and has a number of advantages over the bullet method.

Announcing the action, Attorney General Robert F. Kennedy said the companies are accused of pooling patents about the jet process; making Borg-Warner, through its Byron Jackson Division of Los Angeles, the exclusive licensing agent for the jet process patent rights; of requiring licensees to accept licenses in the pool to get any, and of discouraging price competition, among other things.

The complaint described Jet Research as the largest producer of materials for the jet perforating process in the country. Jet Research is allegedly under joint ownership of Borg-Warner and Halliburton.

Residual Price Drops

Residual-oil prices on the USA East Coast dropped generally from March to April, but were higher than a year ago, it is reported by the Office of Civil and Defense Mobilization.

There was "a marked reduction" in the full tanker price of oil delivered to electric utilities in the Carolinas, Georgia, and Florida, as the price went from $2.40 a barrel to $2.23. For all areas of the USA East Coast, the tanker price in April was $4.24, against $2.06 in April of 1960 and against the recent high of $2.97 in April of 1957.

Interior Studies Import Quotas

The Department of the Interior is taking a new look at the sliding scale basis for import quotas in view of the court action by Standard Oil Co. (N.J.).

Officials now are on notice that unless they end or sharply modify the sliding scale that gives a better break to smaller refiners in import quotas, they face a hard attack in the courts. Chances are that little court action will come in the Jersey Standard action until the new import rules are announced by the department in the last quarter of this year.

But if the sliding scale is continued with little change, then Jersey may be expected to press for action in the courts to upset it.

Under the sliding scale, refiners with less than 10,000 b/d of inputs in districts I through IV are given 11.1% of their refinery inputs in import quotas. Refiners with 300,000 b/d or more are given 3.7%. Jersey was entitled to 38,088 b/d under this formula, but actually received 42,980 b/d by virtue of the floor for historic importers. If all refiners were given the same percentage—9.5%—Jersey would have received 77,500 b/d. That is what Jersey wants.

This seems eminently reasonable to many in the industry, but small refiners are fighting to keep what they have. They have the help of the Small Business Administration, the House and Senate Small Business committees and of some U.S. Department of Justice officials.

Pipeline

Administration Taking Eisenhower Line

The Kennedy administration, after some hints that it would help passage of several antitrust measures backed by small business, now is opposing them just as the Eisenhower administration did.

"It says no with a smile, but it still says no," a representative of a gasoline dealer organization explained.

Thus, fair trade pricing is still opposed by the administration of President Kennedy. So is a "below cost" sales bill to curb price discrimination. So is a "functional discount" measure to assure sales to wholesalers at less than to retailers. So is a measure to divorce tire retailing from tire manufacturing.

On one measure there has been a change. Most of the Kennedy agencies are in favor of a measure to let the Federal Trade Commission issue a temporary injunction against certain pricing and other practices at the time it files a complaint against these practices. The Eisenhower administration, while never on the record officially, was understood to be opposed.

Military Purchases Rise Slightly

The Department of Defense expects to receive 723,000 b/d of all types of petroleum products in fiscal year 1962, which began July 1, 1961. This compares with 720,000 b/d in fiscal 1961, 752,000 b/d in the first quarter of 1961, and 757,000 b/d in the second quarter of 1961.

About two-thirds of the first quarter receipts were from U.S. sources and the rest from overseas. Actual figures are 488,000 from U.S. and 264,000 from overseas.

In the last half of 1961, the military expects to receive 718,000 b/d, and in the first half of 1962 some 730,000 b/d.

Volumes of individual products to be received in 1962 are as follows (in 1,000 b/d): 94 of aviation gasoline against 100 in 1961; 344 of jet fuel against 338 in 1961; 45 of motor gasoline against 47; 51 of diesel fuel against 57; 17 of other distillate fuel oil against 16; 130 of navy special fuel oil against 129, and 42 of other residual fuel oil, the same as in 1961.

Canada's Import Share Up

Canada is now getting a larger share of the total oil imports to the United States and Venezuela is getting less.

That fact stands out in an analysis of oil imports by source in three periods March 11, 1959 to Dec. 31, 1959, the first nine months of the import program; the first half of 1960, and the first half of 1961.

Thus, Canada accounted for 6.4% of total imports of crude oil and products in the first nine months of the program, or 96,400 b/d; by the first half of this year, she had climbed to 9.2% or 162,300 b/d.

Venezuela, which accounted for 52% of the total imports in 1959, some 785,000 b/d, slumped in percentage to 47.4 in the first half of 1961. Since the total of imports allowed was greater this year, Venezuela managed to increase its flow to the U.S. to 832,000 b/d.

The Middle East as a whole was down in share of the market, but up to 349,200 b/d in volume of imports. There were gains by Saudi Arabia, Iran and Egypt, but Kuwait and the Neutral Zone fell off.

Middle East Earnings Still High

The Middle East continues to return a high rate of earnings compared to direct in petroleum, according to a new analysis of U.S. assets and investments abroad by the Department of Commerce.

The U.S. petroleum industry as a whole has a total of direct investments outside the U.S. of $10,944 million. And the earnings on this investment in 1960 were $1,282 million.

In the Middle East, the record is better. Investment was $1,119 million and earnings were $717 million. For Venezuela, the figures are investment of $1,995 million and earnings of $321 million. For Canada, the figures are $2,667 million and $97 million. For United Kingdom $600 million and $53 million.

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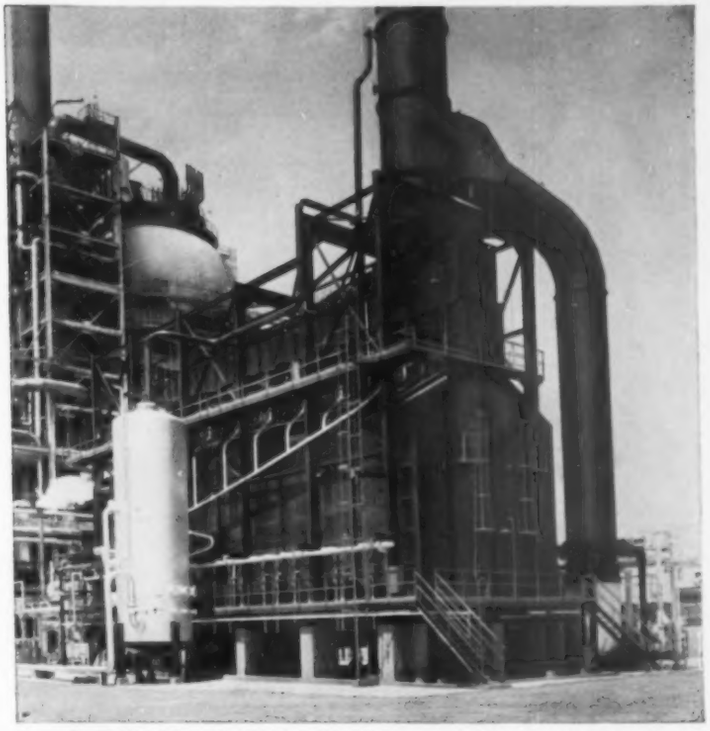

Heater for Humble's Bayway Refinery, Linden, N. J. Large capacity, high thermal efficiency. Specially designed integrated heater, air preheater, auxiliaries and stack in compact design occupy minimum space.

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Finally, there was one other difficult design condition. The new heater would be required to operate for long periods without shutting down for maintenance or cleaning. The Lummus design included steam soot blowers which have kept both the bare tubes and studded tube in the convection section clean. The heater fires on heavy residual fuel oil having a very high solids content.

Lummus designs horizontal and vertical tube oil heaters to any size from 100,000 to 300,000,000 BTU/Hour for any process, anywhere in the world. Because Lummus offers *every* type of oil heater, you can be sure that we will recommend the *right* unit for your needs. Consult with Lummus on your next oil heater—large or small.

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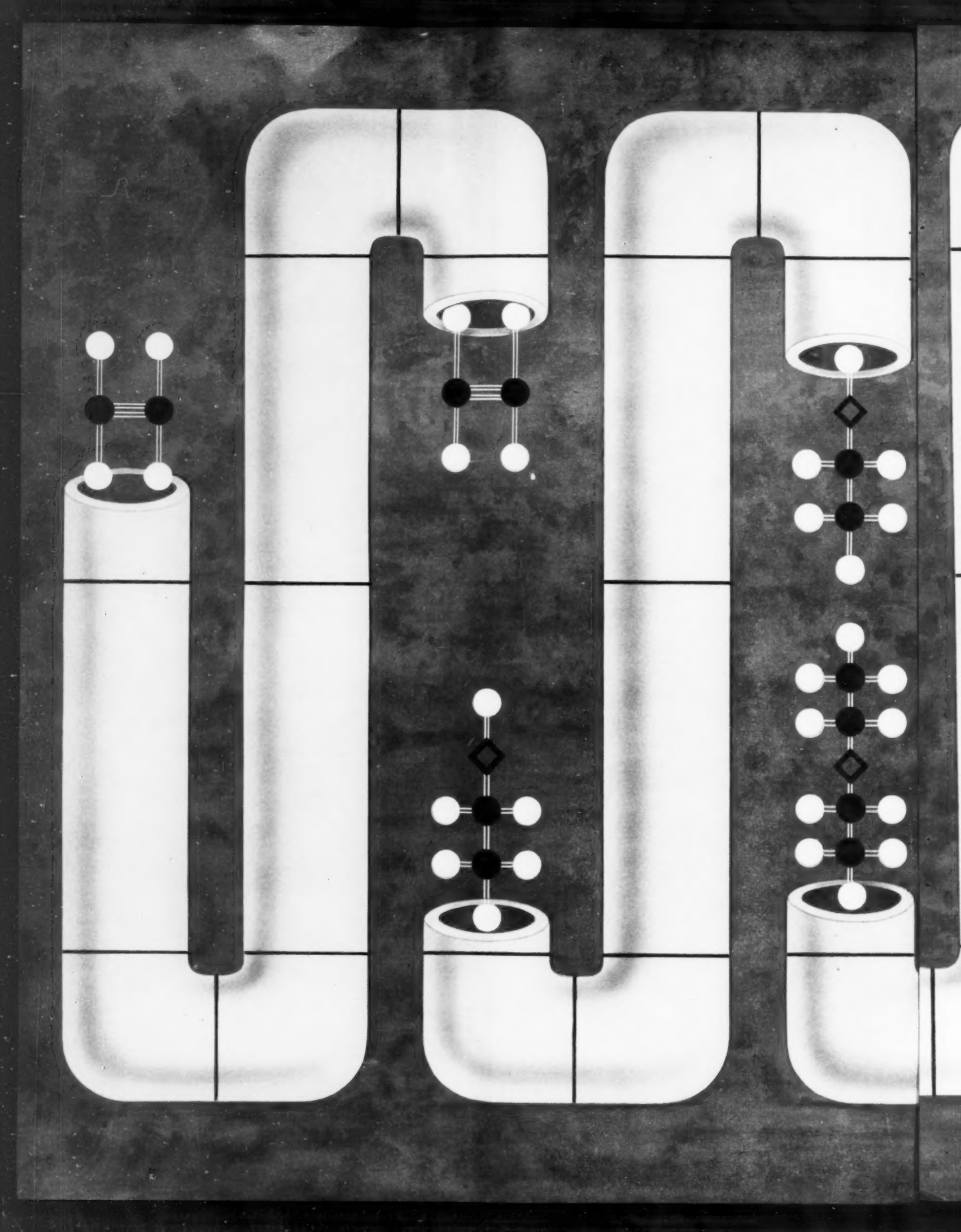

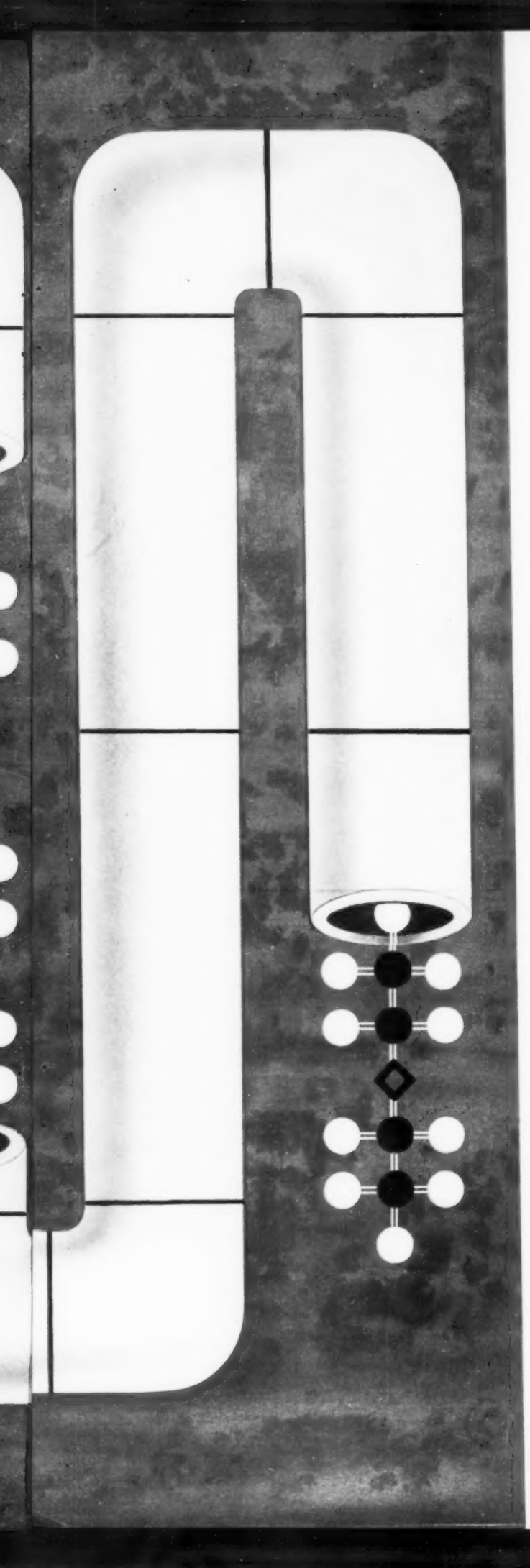

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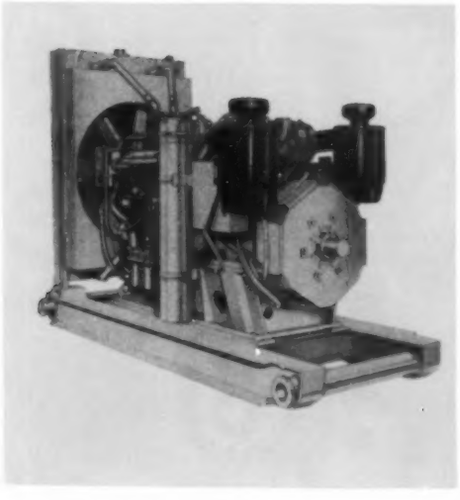

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Shell-Metal Box Packaging Link

Shorko Ltd., London, announces that agreement in principle has been reached with Metal Box Co. Ltd., for the formation of a joint British company whose initial object will be to erect and operate a factory in the UK to make polypropylene film and film products. This will be held 60% by Shorko and 40% by Metal Box and it is stated unofficially that the project will involve the investment of several million pounds.

Shorko was registered last November as a private company with a nominal capital of £1,000 in ordinary £1 shares divided equally between the Shell group and the Sales and Development Co. of National Distillers Corp. (International) SA, of Zug, Switzerland. The registration was an outcome of the earlier announcement, in July, that Shell International Chemical Co., London, and National Distillers & Chemical Corp., New York, were to form a company to operate from London for developing plans for producing and marketing polyolefin film and plastic packaging materials outside the US and Canada. The three representatives on the Shorko board are A. V. Billinghame, A. D. Koelman and D. A. Rowe, while the US partner is represented by J. C. Bierwirth, W. P. Marsh and H. J. Samuels.

This is Shell's first interest of this kind in the plastic packaging industry where a company with which it is associated will be fabricating the raw material.

Grangemouth-Granton Pipeline

The Scottish Gas Board is to build a 21-mile pipeline costing £1,360,000, to carry refinery gas from British Petroleum's Grangemouth plant to the gas works at Granton, near Edinburgh, where it will be reformed and mixed with the town gas supply during 1962. A further 23-mile line from Granton to Armadale and Falkirk will provide a link with the Scottish gas super grid. The chairman of the Scottish Gas Consultative Council said this project would take the place of the proposed third extension of the Lurgi coal gasification plant at Westfield, Fife.

Rank Expands in Gasoline Retailing

The Ministry of Transport has awarded The Rank Organization Ltd., the contract to develop and operate the only service area that will be allowed on the new Medway motor road. On this 20-acre site, four kinds of motor fuel will be on sale from 48 pumps (24 on each carriageway) and five kinds of oil will be stocked. A 24-hour service will be provided as well as facilities for emergency repairs, and there will also be a cafeteria, restaurant, refreshment kiosk and two shops.

The company entered the gasoline retail trade last April when it opened its first station on the site of one of its cinemas in Worcester, and plans have been made for a number of other stations which are now awaiting official approval.

Middle East Gas Turbine Record

Two gas turbines installed at a gathering center in Kuwait Oil Co.'s Burgan oilfield have been operating over 21,000 hours each without opening up, and they still show no need of internal inspection nor indication of any deterioration in performance. Supplied by Ruston & Hornsby Ltd., Lincoln, these TA turbines are running on natural gas, each driving a 90,000 b/d crude oil pump. KOC now has 11 TA's in the field, making this company and Aramco joint second largest users of this particular prime mover. IPC, the largest user, has 24 units in service or being installed. Altogether the Middle East total in use is 76, with nearly a million cumulative running hours, and the figure for total orders is nearly 150.

Methane Import Project

The growth in the use of petroleum in town gas enrichment, the Gas Council's desire to import liquefied methane from the Sahara, and the National Coal Board's opposition to this project in favor of Lurgi plant expansion, all figure prominently in the 130-page *Report and Proceedings (Volume 1) of the Select Committee on Nationalized Industries: Gas Industry* (Stationery Office, 6s 6d).

This survey examines the industry's present position, its difficulties and opportunities for the future, and the ways it is proposed to meet them. In the last context it brings clearly into public light for the first time the broad differences of opinion between the National Coal Board and the Gas Council on the latter's proposal, now before the Minister of Power for approval, to import enough methane to make 160 mmcf/d of town gas—equivalent to about 352 million therms a year against the industry's total gas sales in 1959/60 of 2,600 million therms. From Canvey Island (Essex) the project envisages a high-pressure trunk main from Thames-side to Mersey-side supplying the seven-area gas boards which so far have agreed to take methane for various uses. The price paid for the imported methane would enable enriching gas to be delivered for 7½d per therm.

The scheme would produce rather more than 10% of the national gas consumption at a capital cost of £10.5 million, comprising £2.9 million for the shore installation and £7.6 million for area boards' reforming plants. The cost of liquefaction and the two ocean carriers proposed would not be the Gas Council's responsibility.

The National Coal Board opposes this scheme for reasons both national and technical, believing the gas industry would be equally well served by developing large-scale Lurgi plants for complete coal gasification. It hopes the Minister of Power will withhold his decision on the methane proposal until the conclusion of a special study now being made by plant constructors on a proposed 109 mmcf/d Lurgi plant costing £18 million. The group has concluded this is the most economic scale: the present operating plant is working at only 30 mmcf/d.

The Select Committee—Parliament's "watch dog" on national expenditure—examines the various arguments put forward by both sides, not with the intention of reaching conclusions on such highly technical matters but with the object of making known their relative advantages and the prospects they offer the gas industry.

In the committee's opinion it is crucial that the cost of production should be reduced as soon as possible if town gas is to hold its position as a fuel. The report stresses not only that it is the duty of the Minister of Power to arbitrate upon the two schemes and decide whether a particular one should go forward, but also, far more important, that his decisions ought not to be delayed.

Lobitos Group Expansion

Manchester Oil Refinery (Holdings) Ltd., subsidiary of Lobitos Oilfields, is acquiring the balance of the ordinary capital of a company engaged in the business of refining and merchanting oil products. The sum paid is £46,704.

Forth Chemicals' Styrene

In Table 6, of the Annual Refinery Review, July 15, 1961, page 108, the entry relating to Forth Chemicals Ltd. under 'Styrene" should read "50,000, expanding to 100,000," and not "80,000, expanding to 130,000."

The position is that present production at Grangemouth is 50,000 ton/yr, including past expansion, and future expansion at Baglan Bay will bring the production total up to 100,000 ton/yr.

The information on Forth's styrene capacity in the survey of petrochemical plants, page 99 of the July 15 issue, is correctly given as 50,000.

BP Aids to Air Refuelling

Two new devices developed by British Petroleum will aid speedier airport refuelling and freedom from contaminated fuel. One of these, the "BP Aquascan," provides for instantaneous check on the presence of water and automatically halts delivery if the permissible limit is exceeded. The other, the "Ranger," developed in conjunction with Rellumit (London) Ltd., is designed to supply fuel to all types of civil aircraft. Though intended primarily for use with hydrant systems, it can also be used in fuelling from mobile tankers. It can fuel superjet aircraft at a maximum rate of 600 gpm through one wing and smaller aircraft at 400 gpm through two wings.

Detergent Foam Nuisance

Replacement on a national scale of the present type of household detergent, which uses alkyl benzene sulfonate as the surface active agent, by a new soft material—Dobane JN—now being tested, would lead to an appreciable reduction in the volume of foam present in various British rivers and canals and would relieve the considerable problems at present facing sewage treatment plants.

This is one of the conclusions given in the fourth progress report of the Standing Technical Committee on Synthetic Detergents (Stationery Office, price 1s 6d). This uses the expression "soft" to describe materials which are more readily decomposed biologically than materials of the tetrapropylene benzene sulfonate type, which are referred to as "hard."

The large-scale trial of the biologically soft detergent described in the third report (World Petroleum, July 1960) has been continued but it has not been found possible to replace more than 80% of sales of the hard by the soft detergent over the area covered by the experiment. It has been confirmed, however, at a full-scale sewage works that over 80% of soft detergent can be removed as against 68% of the hard material.

The committee admits that, while affording great improvement, Dobane JN does not provide a complete solution of the foam and sewage plant problems arising from the use of synthetic detergents. Further improvement of the detergents in use, or the development of a new active agent, is necessary.

Appointments

DERRICK KLEEMAN has joined the board of Mobil Holdings Ltd., consequent upon the success of the latter's bid for O. & M. Kleeman Ltd., fabricators of plastic goods. **R. B. MADDEN**, assistant to the president of Mobil Chemical Co., and **P. B. UNWIN**, executive of Mobil Holdings, have been made directors

(Continued on page 12)

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(Continued from page 10)

of Kleeman. **DR. R. LESSING** has relinquished the managing directorship of Hydronil Ltd., which he has held since its formation in 1914 and has been appointed deputy chairman.

The Cape Asbestos Co. Ltd., which is now the holding company for the whole Cape group, announces the appointment as directors of **L. C. DAWSON,** head of the group's engineering division, and **DR. R. GAZE,** chief scientist.

J. T. Caddie

H. F. Barnes

H. F. BARNES and **J. T. CADDIE** have been appointed manager and assistant manager, respectively, of the Rotherhithe plant of Castrol Ltd. Mr. Barnes, who has been assistant manager since 1950, replaces W. E. Ryde, who has retired. Mr. Caddie has been at this plant since 1938.

L. WILLIAMS, who retired recently from Shell International Chemical Co. and who was managing director of Shell Chemical Co. from 1955 to 1960, has been made a member of the British Transport Commission and has become responsible for commercial affairs.

JOHN C. GARRELS has been appointed managing director of Monsanto Chemicals Ltd. He succeeds **D. R. MACKIE,** who has resigned owing to illness but who remains a member of the board. Mr. Garrels joined Monsanto from the plastics division of the American parent company early this year and has been acting as managing director since Mr. Mackie's illness in March.

D. E. Stephan

DEAN E. STEPHAN has been appointed managing director of Chicago Bridge Ltd., London, British subsidiary of Chicago Bridge & Iron Co. He succeeds **CECIL A. WOOTEN,** who is now serving as co-manager of the U.S. parent's newly-formed French affiliate—Chicago Bridge et Provence.

British Equipment News

The Telegraph Construction & Maintenance Co. Ltd. is marketing a motorized valve system for tankers whose features are claimed to include simplicity and extreme reliability. This incorporates a hydraulic ram connected to a modified Blakeborough "Flexi-Ring" rising spindle gate valve fitted with a non-threaded spindle in place of a threaded type. The Telcon system can be applied to any type of valve and can be equipped for remote control.

Both the ram operating the valve and the actuator for the valve position indicator are enclosed in an oil-tight case, and as the ram is set to close at one pressure (5,500 lb) and open at a greater thrust (7,000 lb), the gate cannot jam in its wedge.

Perkins Gas Turbines Ltd., Peterborough, has received an order from Phillips Petroleum Co. for a Solar Aircraft Co. Saturn 1,100 hp gas turbine for use in driving a new type Carter LPG pump in Oklahoma pipeline operations. This will boost pressure at various location sites and deliver 1,900 gal/min at 2,500 ft head. This application represents a big departure from standard units and reduces overall length of the pumping package from 178 to 98 inches.

Delivery time played an important part in placing the contract for electrical equipment for an outdoor 34.5 kv substation recently completed for a large refinery now building in Turkey, and it is noteworthy that the equipment was shipped within four months of placing the order. This was supplied by *Crompton Parkinson Ltd.* through its associates Cooke & Ferguson Ltd. (Manchester) and British Electric Transformer Co. (Hayes, Middlesex), the order covering five oil circuit breakers, 10 isolating switches, overhead busbars, weatherproof kiosks, and relay and metering equipment as well as two 5,000 kva and two 200 kva transformers.

Supply enters over a double circuit 34.5 kva overhead line each terminating on a structure carrying surge diverters and the incoming 400 amp isolating switches. Each supply is controlled by a fully automatic bulk OCB and feeds through busbar isolating switches on to the substation busbars which are sectioned by a non-automatic OCB. All OCB's have arc control devices and are rated at 800 amp with short circuit rating of 500 mva at 34.5 kv. The plant can take a duplicate supply with 100% standby facilities, although the system is designed for both incoming units and bus-section breaker to operate in the enclosed position.

Elliott Brothers (London) Ltd. has negotiated a license of very wide coverage with Office National d'Etudes et de Recherches Aeronautiques, France, to manufacture and sell two gas analyzers of the paramagnetic type, a very advanced design. They are primarily intended for determining oxygen content in gaseous mixtures and have found extensive application in controlling furnace atmospheres in processing.

New Publications

"1960 Statistical Review of the World Oil Industry"—No praise can be too high for the reference value of this guide to a very wide range of world oil data assembled and interpreted by British Petroleum Co. Its value is enhanced by the fact that all statistics are in both long tons and barrels (or b/d). The main sections cover: (a) world "published proved" reserves at end 1960 and 1959, and ratio of reserves to production in major areas 1950 and 1960; (b) world production 1960 and 1959; (c) world consumption 1960 and 1959, and estimated civil consumption of major products 1960; (d) world supply and demand 1960, and international oil trade 1960; (e) world refining capacities at end 1960 and 1959, and percentage refinery yields 1960; (f) world tanker fleet end 1960, age and size, new building and employment, and (g) graph of world energy demand 1920 to 1960. Each section has a depictive chart or graph. There is also an historical section giving brief statistical data of the main sectors of the industry over the past 10 years and a short list of conversion factors. Copies are available from the company's Information Department, Britannic House, Finsbury Circus, London, E.C. 2.

"Quality Assessment of Petroleum Products"—This is a completely new version of the Institute of Petroleum's 1954 publication *"Significance of Properties of Petroleum Products."* It was felt that it would be of far greater value to treat the subject on the basis of products rather than, as was done originally, from the standpoint of the individual properties, and this has now been done by a group of specialists. For each product there is also a list of suggestions for further reading. The work is still, as was that of 1954, intended to supplement the volumes of IP standard test methods and copies are available from the IP at 611 New Cavendish Street, London, W. 1, price 15s.

"Reports on Clearance of Oil Pollution"—A publication (with maps) issued by Esso Petroleum Co. for the guidance and benefit of all who may at any time be concerned with the difficult problems associated with removing oil pollution from beaches and from the sea and inland waterways. Condensed information is given on the steps taken, and the results achieved, following two serious spillages in 1960, at Milford Haven and Fawley, respectively, which had widespread effects. Copies can be had from the company's Public Relations Department, 36 Queen Anne's Gate, London, S.W. 1.

"Thermex"—This is a eutectic mixture of 73.5% (wt) diphenyl oxide and 26.5% diphenyl and in this very informative brochure, issued by the Heavy Organic Chemicals Division of Imperial Chemical Industries, considerable technical detail is given on the properties, applications and advantages of this heat transfer medium over the simple direct methods of heat application. It includes a list of equipment manufacturers who can give detailed advice on its use. Copies available from any ICI sales office, or from the company at Millbank, London, S.W. 1.

Dutch Chemical Firms Merge

Koninklijke Zout-Ketjen N.V. has been established as a result of the merger of N.V. Koninklijke Nederlandsche Zoutinindustrie (KNZ), and Koninklijke Zwavelzuurfabrieken vorheen Ketjen N.V.

Dow Plastics Service in Europe

Earl R. Smith has been made resident customer service engineer for Europe to provide technical assistance to the growing number of plastics customers for Dow Chemical International S.A. He will be located at the plant in Rotterdam, Netherlands.

The company also plans a plastics technical service laboratory in Livorno, Italy, site of a new polystyrene plant now under construction.

CB&I in France, Australia

Formation of companies in Australia and France to serve the growing need for metal plate storage tanks and processing structures has been announced by Chicago Bridge & Iron Co., in association with three foreign firms.

The new companies are Chicago Bridge-Lennox (Pty) Ltd. with headquarters in Alexandria, New South Wales, Australia and Chicago Bridge et Provence, headquartered in Arles-sur-Rhone, France.

Chicago Bridge-Lennox (Pty) Ltd. is owned in equal shares by CB&I and Australian Consolidated Industries. It formerly was named Lennox Heavy Transport & Erection Co. (Pty) Ltd. and was a subsidiary of ACI. It offers design, engineering, fabricating, heavy transport and erection services to private industry and governmental agencies throughout Australia. Robert L. Hull, formerly of CB&L's International Sales division, is manager of the Australian firm.

Chicago Bridge et Provence is owned jointly by CB&I, Constructions Metalliques de Provence, Arles-sur-Rhone, and Constructions Metalliques de Ardennes, Sedan. Co-managers of Chicago Bridge et Provence are Pierre Laval, widely-known French industrialist who also heads Constructions Metalliques de Provence, and Cecil A. Wooten of CB&I.

Avondale Appointments

Henry Z. Carter has been appointed president of Avondale Shipyards, Inc., following merger of Avondale's parent company, Ogden Corp., with Gulf States Land and Industries, Inc. He succeeds J. H. Bull who has been president since 1938 but who remains a director. Sam P. Stone was elected executive vice president and Edwin H. Fletcher, vice-president-engineering.

Mission Promotes Five Men

Recent promotions at Mission Manufacturing Co. have been announced by Jack Stewart, domestic sales manager. C. E. Van Loozen, former Western district manager, has been appointed Industrial sales manager. F. J. Herbert, former Southeastern district production sales representative, will become Western district manager. Harold Herren replaces him in the Southeast. Melton Wright has been appointed to the position of sales administrator. Johnny Warren has been appointed to packaged gas turbine, Round Power, sales.

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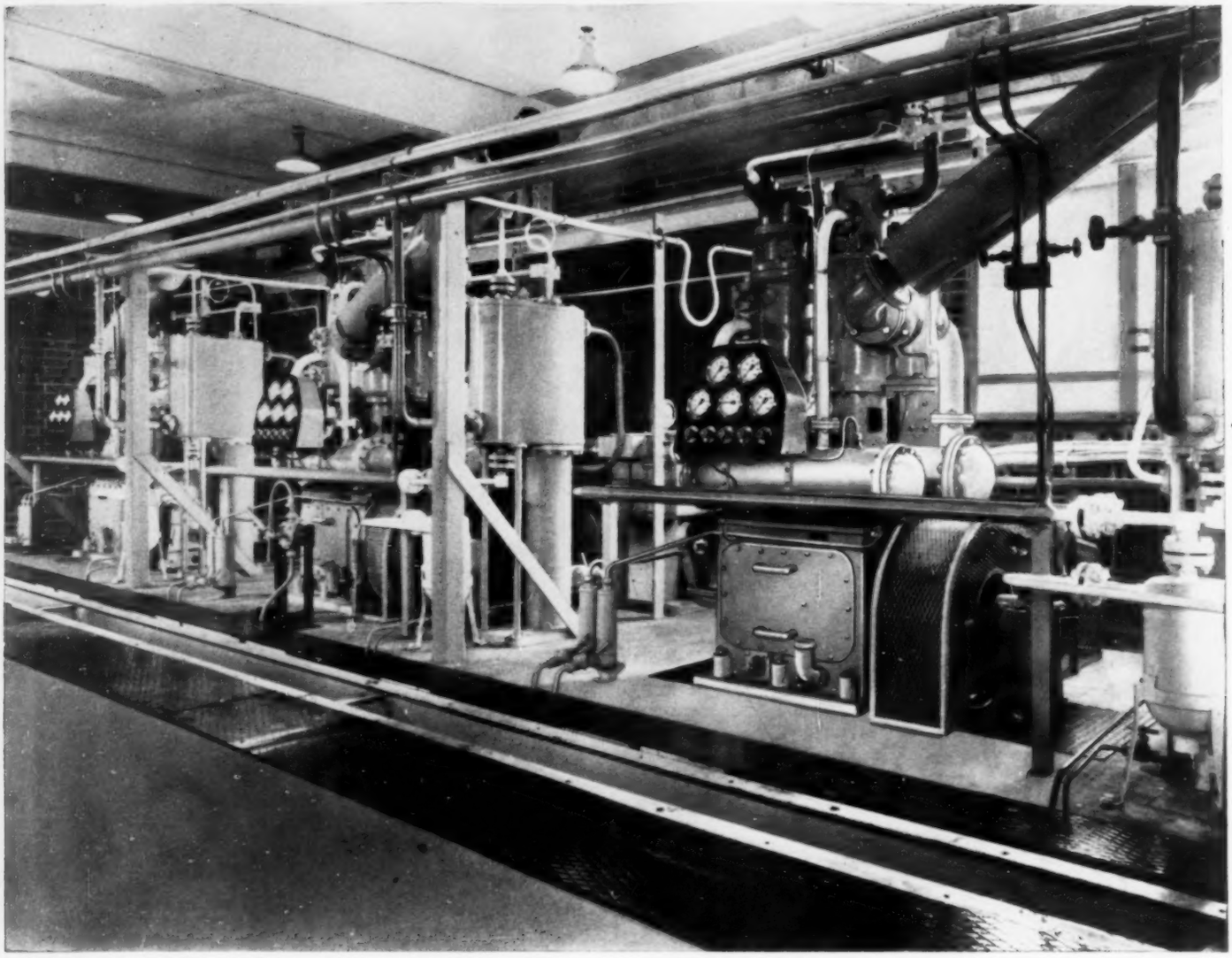

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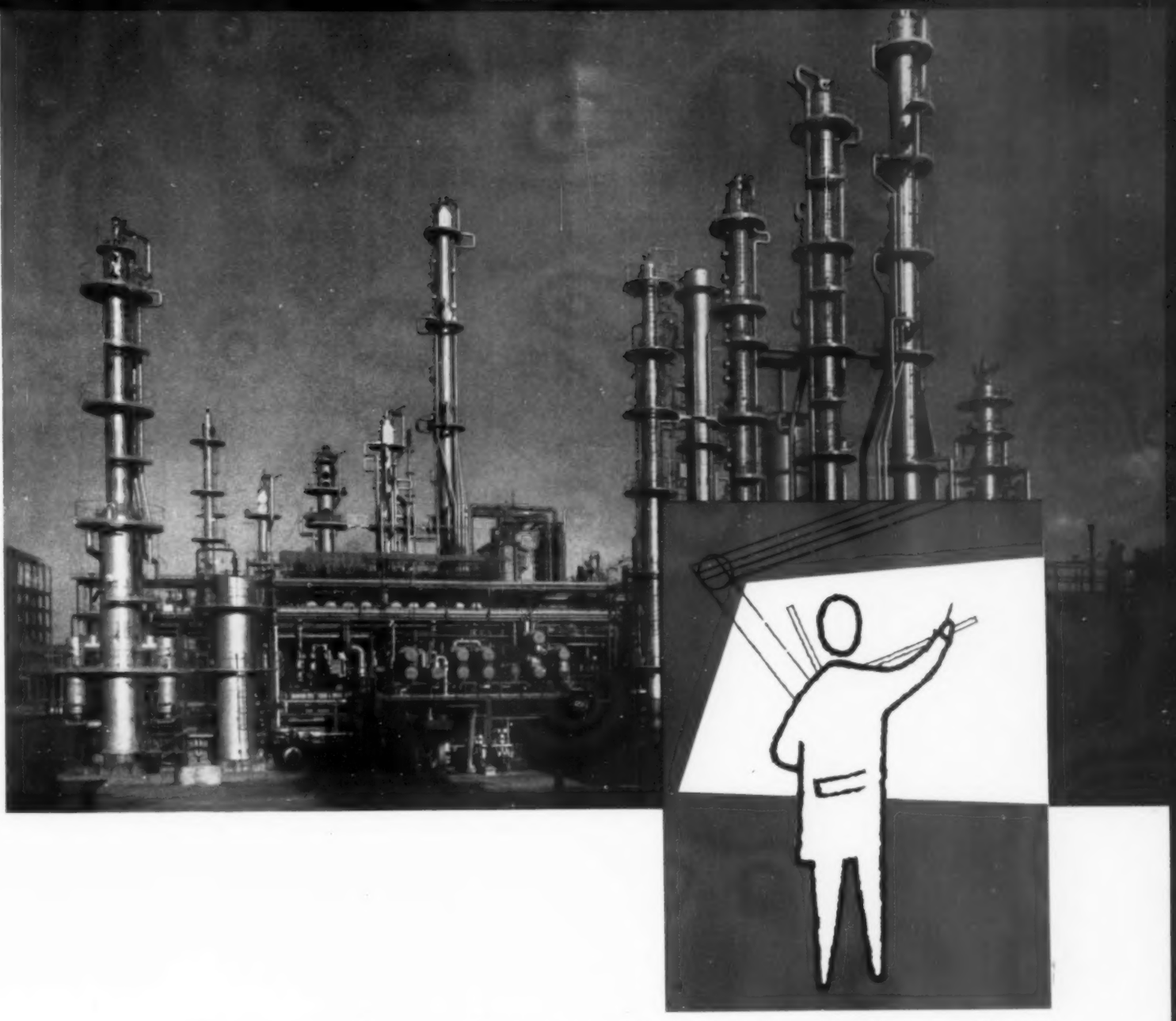

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CANADIAN NOTES

Home Oil, United Oil Sell Bonds

Home Oil Co. Ltd., and an affiliate, United Oils, Ltd., Calgary. have sold $20 million worth of 6¼% secured bonds to two New York companies. The Prudential Trust Insurance picked up $9.8 million worth of Home Oil subscription and $4.2 million of United Oils' subscription. Mutual of New York subscribed for $4.2 million worth for Home Oil and $1.8 million for United Oils bonds.

Proceeds of the bonds, which are due in 1976 are being used to retire bank debt and increase the firms' working capital.

Will Not Curb U.S. Production

An orderly expansion of markets for Canadian crude oil and natural gas liquids in the northern United States should not cause any material dislocation of U.S. domestic production, British American Oil Co. president E. D. Loughney of Toronto recently told the New York Society of Security Analysts.

Provided that Canadian refinery demand for crude oil and natural gas liquids expands as contemplated under Canada's National Oil Policy, he said that annual increases in export demand in the four years after 1961 need be no larger than about 23,000 b/d. Furthermore, he pointed out that this annual increase in exports could be met by satisfying only the anticipated normal growth rate of two or three per cent a year in the northern states now served by existing pipeline facilities.

Under the voluntary National Oil Policy program, Canadian production is expected to increase from 544,000 b/d in 1960 to 640,000 b/d in 1961 and 800,000 b/d in 1963.

"With the progress that we anticipate will be made in the current year, and with full implementation of the Policy in expansion of our own domestic markets, we are certainly hopeful that this target level will be met," Mr. Loughney said. He added that in meeting the 1963 target not less than 50% of the required increase is expected to come from expansion of domestic markets.

Demand Up 4%

Total demand for oil products in Canada in 1961 is expected to average 890,000 b/d, up 4% over the 1960 average of 855,000 b/d. Domestic crude production will supply 472,000 b/d, up from 426,000 b/d in 1960. Imports of both crude and products will be reduced.

Arctic Economics

Proximity to tidewater is probably the most important single factor in selecting location for Arctic drilling, said E. J. Baltrusaitis, exploration manager of Dome Petroleum Ltd., discussing Dome's new Melville Island wildcat, first in history of Canadian arctic exploration. This is more important than exact nature of structure disclosed by photogeological reconnaissance.

First Wildcat in Arctic

Drilling operations at first Canadian Arctic Islands wildcat well may not go beyond 13⅜-in. surface casing this season. Dome et al Winter Harbor 1, on Melville Island, was to be spudded by end of August. Supply ship was scheduled to reach location, from Montreal, by August 18, when harbor should be clear of ice.

Waterton Biggest Gas Field

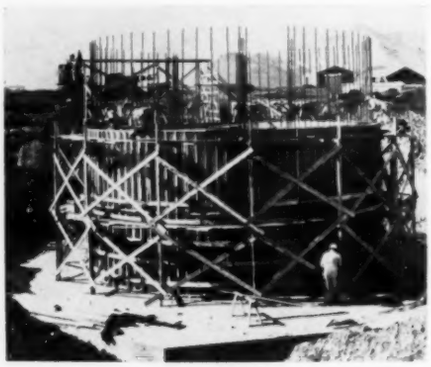
Possibly biggest of all Canadian gas fields is future shaping up for Waterton Park wet gas field in southwestern Alberta. Six drilling rigs are currently working on development wells, two on wildcat extension tests. Shell of Canada is principal operator. Texaco also has large interest. Field has already been provided with pipe line outlet through Alberta Trunk system.

"Oil in Ground" Standard Dropped

Criterion of "oil in the ground" as a valuation of company assets has been practically abandoned in western Canada in favor of evaluation of production rates and present value of future production. Drastic reduction pending on January 1, 1962, in Alberta economic allowances has precipitated revision of thinking by financial institutions.

Drilling Down

Western Canada drilling was down 11½% in first seven months of 1961 with 1,253 well completions compared to 1,416 in same period, as Alberta continued weakest province and Saskatchewan strongest. July was best month of past four, with 221 completions—down only 8½% from 241 drilled in July of 1960.



Workmen are shown forming the pedestal for the 375-ft. waste gas disposal chimney at Shell Oil Co. of Canada's gas processing and sulfur manufacturing plant under construction near Pincher Creek, Alberta. The taller-than-average chimney is one of the many precautions being implemented by Shell to prevent air pollution from the plant's operations. Approximately 560 men are being employed on the construction job and 200 cu. yds. of concrete are being poured per day. When the plant is completed toward the end of 1961 the sulfur recovery facilities, with a design capacity of 1,500 long tons per day, will be the largest in North America producing sulfur from natural gas.

New Approach to Gas Reserves

Several independent companies are trending to new approach to Alberta gas reserves. Acquisitions sought now are properties in "balanced" area where they can move gas, if found, through both main pipelines. Trans-Canada to east and Alberta & Southern to south offer diversified markets.

Shell Enters Off-Shore Activities

Shell Oil of Canada, Ltd. is expanding into offshore activities in Canada for the first time. The company has applied to the Federal Government for exploration permits totalling 11.5 million acres of offshore lands along the western coast of Vancouver Island and Queen Charlotte Sound.

J. F. Redmond, vice president in charge of Shell's exploration and production activities in Calgary, said geological studies will be made, the results of which are expected to lead to seismic work and drilling.

Trans Canada to Add Compressors

Because of rising gas sales, Trans Canada Pipe Lines (operator of world's longest pipeline) has earmarked $8.7 million for additional compressor facilities. By year-end, company will have added 53,760 hp—raising compressor capacity to total 500,000 hp. Firm estimates 71% increase in gas sales during 1961, and another 12% rise in 1962.

Gas Well in B. C.

A significant natural gas discovery in northeastern British Columbia has been announced today by Hudson's Bay Oil and Gas Co. Ltd. The discovery well, Hudson's Bay Cypress B-27-F-94-B-15, recorded natural gas flows as high as 11.6 mmcf/d on a drill stem test in the Baldonnel formation. It is located on a drilling reservation in the company's Sikanni Chief Acreage Block, where Hudson's Bay Oil and Gas has 1,372,000 net acres. A net pay thickness of 113 ft has been indicated in the discovery, which is 100 miles northwest of Fort St. John and 12 miles from the nearest production.

Union Oil Reactivates Affiliate

Union Oil Co. of Canada Ltd., whose Canadian registry dates to 1921, is being re-activated and become a full-fledged subsidiary of Union Oil Co. of California.

All the Canadian properties owned by the U.S. company are being transferred to the subsidiary which has made application for listing on Canadian stock exchange.

During 1960, Union Oil Co. of California had interests in more than 9 million acres in leases and reservations including net production in 150 oil and gas wells in Western Canada.

Prior to this corporate change, the U.S. company operated an exploration and development division out of Calgary, Alberta.

Personnel Changes

GRAHAM W. GARTON has been appointed to the newly-created post of government representative for British American Oil with headquarters in Ottawa. Mr. Garton will be the company's general executive representative in the capital as well as maintaining specialized marketing relations with government departments and agencies and foreign legations. He has been assistant general manager of marketing since 1959, and previously held key managerial posts in marketing at head office and in Pacific and Ontario divisions.

RICHMOND M. ANDERSON has been named secretary and staff assistant to the president of Canadian Husky Oil Ltd. and its subsidiary, Husky Oil Co. Mr. Anderson was formerly an executive secretary on the personal staff of Howard Hughes, president of Hughes Tool Co.

Desk & Derrick Tour

On Friday, June 16, 1961, eleven New York D&Deris left Idlewild Airport for a 17-day, oil-seeing tour of the Caribbean area. After visiting Montego Bay, Jamaica, they motored to Kingston for the takeoff for Curocao, Netherlands Antilles, where sightseeing and shopping were the program. Thence to Aruba, N.A. In Aruba, they were conducted through Standard Oil's refinery and entertained at lunch in the Esso Club by Lago Oil and Transportation Co., Ltd. Next on the itinerary was Maracaibo; a lecture and film in the Shell Building, a visit to Creole's lake installations, and entertainment by the Maracaibo Petroleum Women's Club.

After touring through the Panama Canal Zone, the group flew to Caracas, Venezuela. Extensive entertainment was provided by Mobil Oil, Shell, Creole, and eight other oil companies of Venezuela. Highlighting the stay in Caracas was a visit with the Minister of Mines and Hydrocarbons, Dr. Juan Pablo Perez Alfonso, an introduction to President Betancourt of Venezuela, a visit to Shell's agricultural station at Cagua.

The final stop on the tour was made in San Juan, Puerto Rico, where sightseeing was jointly sponsored by Texaco, Shell and Esso Standard.

The members of the tour group were: Catherine McGarrity, WORLD PETROLEUM; Gertrude A. Munafo, Texaco Development Corp.; Edna Hurry, Standard Oil Co. (N.J.); Adelaide deRose, Mobil Oil Co.; Edith M. Jones, Commonwealth Gas Corp.; Doris V. Finnelly, Socony Mobil Oil Co.; Sophia L. Schierenbeck, Gulf Oil Corp.; R. Nell Hagaman, Shell Oil Co.; and three associate members—Helen E. Hutchinson and Margaret A. McCurdy, American Oil Co., and Elsie Jones, Gulf Oil Corp.

Socony Reorganizes Marine

A new organization plan for Socony Mobil Oil Co.'s marine transportation department went into effect Sept. 1. The plan is intended to reduce costs and to improve the company's ability to meet its expanding world-wide marine transportation needs.

All marine operating activities are divided between two line managers reporting to Charles F. Scott, general manager of the department. Parker S. Wise will be responsible for all United States marine operations. Reporting to him will be Walter R. Matson (East Coast operations); Hugh C. Ellis (West Coast operations); and Arthur E. Fischer (inland waterway operations). Herbert A. Steyn, Jr. will be responsible for all international marine operations.

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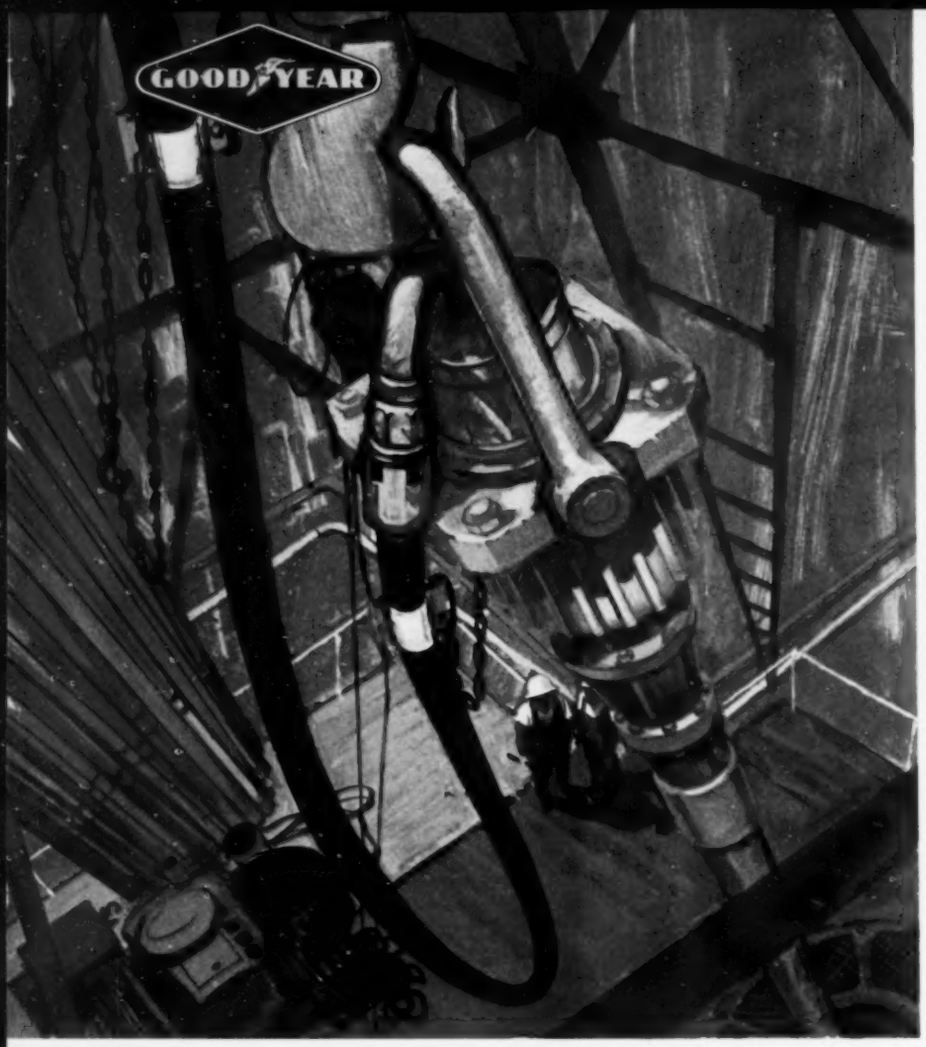

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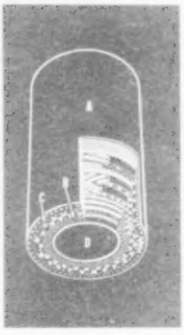

3153 H HIGH-PRESSURE ROTARY HOSE. This crush-, kink-, and weather-resistant Rotary Hose is unsurpassed in ruggedness of construction. Where rock is hardiest, bottom-hole pressure most extreme, Goodyear hose outstrips all others in performance, endurance . . . and economy!

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A. Cover of extra heavy gauge compound resists gouging, weathering and wear.
B. Plies of heavy fabric plus high-tensile cable steel wire and wire helices at ends for exceptional strength with flexibility.
C. Fabric breaker strip.
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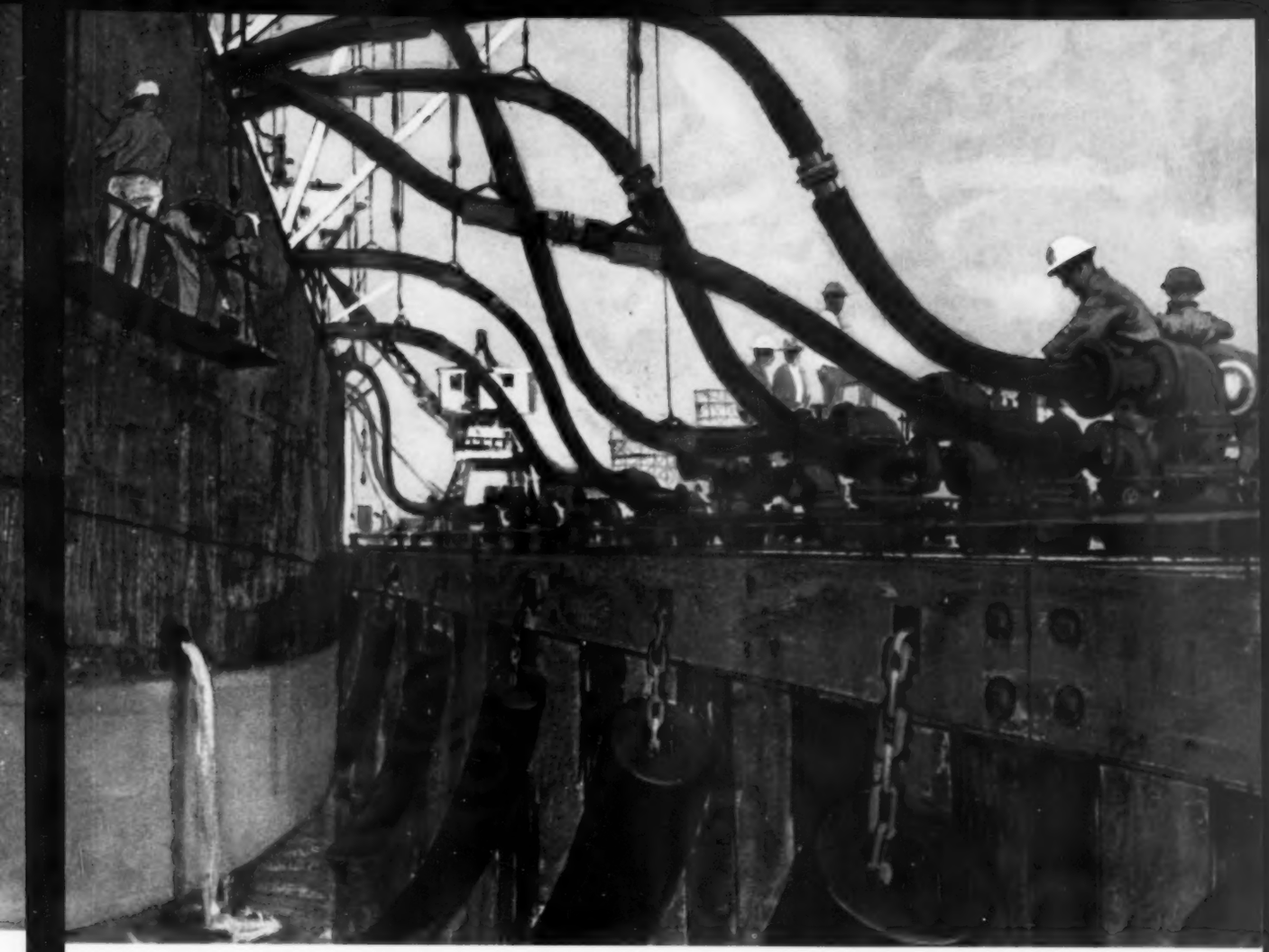

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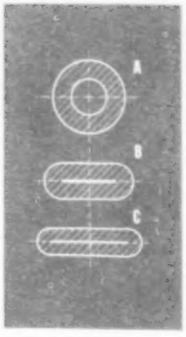
Style MH Oil Suction & Discharge Hose (RB)

A. Helix of flat, noncorroding, galvanized steel wire plus ply of heavy fabric coated with oil-resistant compound.
B. Tube of gasoline- and oil-resistant synthetic rubber.
C. Reinforcing plies of heavy fabric plus helix of round steel wire.
D. Oil-, age-, abrasion-, and weather-resistant cover.



ALL-RUBBER DOCK FENDERS.

Built for extra heavy shocks, Goodyear All-Rubber Dock Fenders soak up thousands of foot-pounds of kinetic energy per foot without significant reaction. This remarkable absorption-power cuts dock piling costs! The fender resists mildew and the destructive action of salt water, ozone, sunlight and marine bacteria. Outlasts other types of fendering with minimum maintenance!

Cylindrical Dock Fenders for protection against shock, abrasion and crushing action

A. Uncompressed 15"size–inside diameter 7½".
B. Compressed by load of 5 tons (approx.) per foot–bore closure 7½".
C. Compressed by load of 110 tons (approx.) per foot–bore closure 11".

GOODYEAR

...FOR FUEL DEPOTS—FLEXWING TANK TRUCK HOSE.

For loading or unloading tank trucks, tank cars or storage tanks, Flexwing Tank Truck Hose is sturdy, strong, yet flexible, even in sub-freezing temperatures. Highly resistant to crushing or kinking, Flexwing handles working pressures up to 200 pounds. And, it's wire bonded for positive dissipation of static electricity.

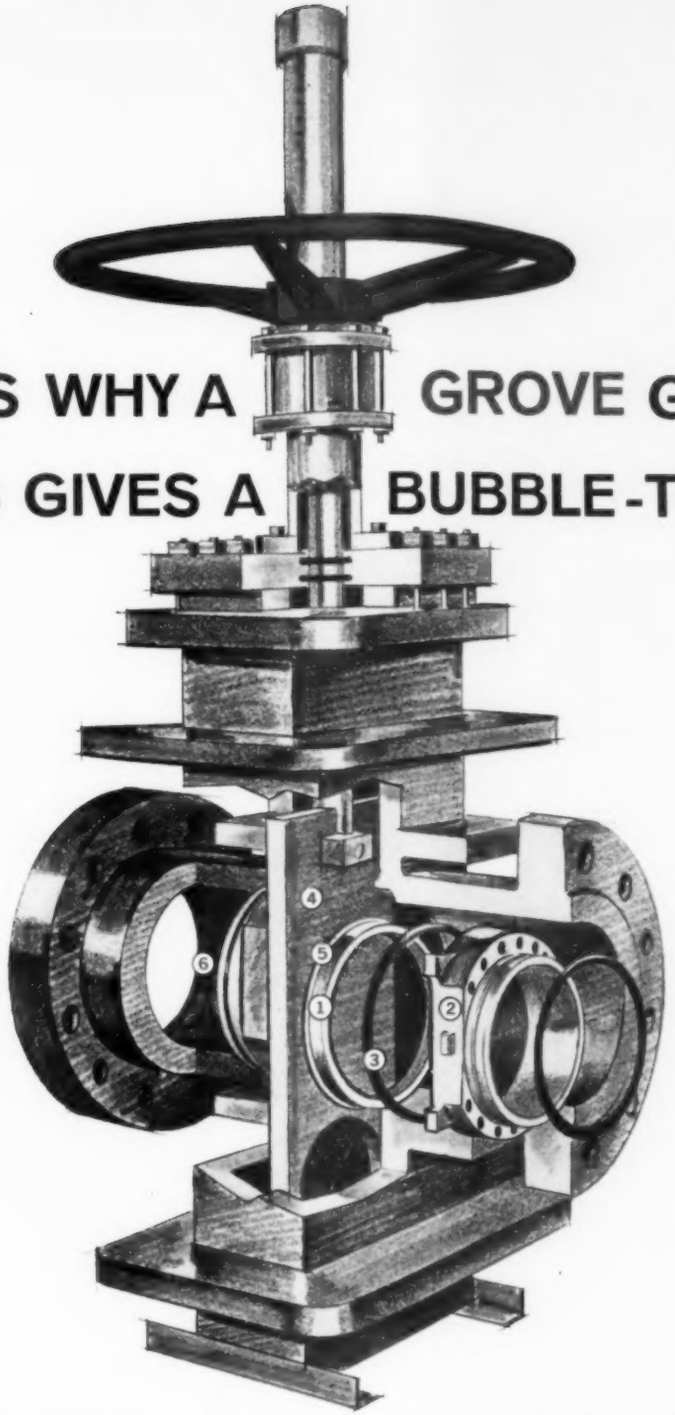
FLEXWING TANK TRUCK HOSE

Sturdy cover is oil-, gasoline-, sun-, weather- and abrasion-resistant.
Reinforced with two braids of horizontal braided synthetic cord plus wire helix.
Smooth, synthetic rubber tube is oil-, and gasoline-resistant.

Flexwing—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio, U.S.A.

GOODYEAR

HERE'S WHY A GROVE G-4 VALVE ALWAYS GIVES A BUBBLE-TIGHT SEAL



Grove protected Seal-"O"-Ring® system is the heart of the G-4. Inner **(1)** and outer **(2)** metal seat rings shield the o-rings **(3)** on each side of the gate **(4)** from damage by line contaminates. Inner seat rings also function as a primary metal-to-metal seal **(5)** backed up by the o-rings. No lubricants or sealing compounds are needed. The floating gate and seats assure fast, easy opening and closing, and positive, bubble-tight sealing; the inner metal rings scrape foreign matter from the gate while the o-rings squeegee it clean. Through conduit **(6)** is provided to assure ideal flow characteristics. Send for bulletin #571.

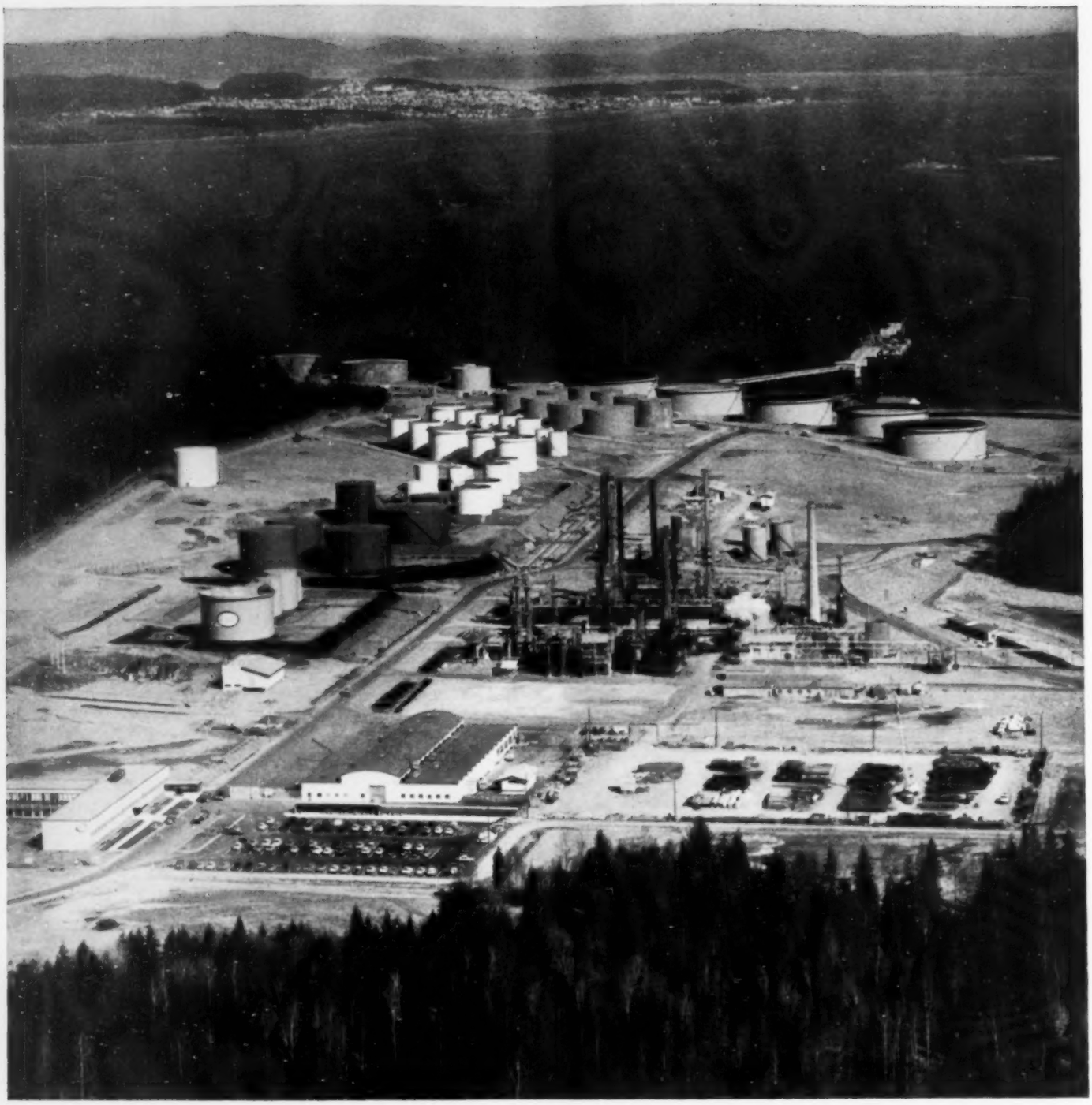
GROVE PIPELINE VALVES

GROVE VALVE AND REGULATOR COMPANY

Oakland 8, California

Subsidiary: Grove France S. A., 24 Avenue de la Grand-Armee, Paris 17e
Western Continental European Sales Representative, except Italy: Pétrochimie, 77 Rue la Boétie, Paris 8e

Licensees: Nuovo Pignone, Casella Postale 487, Firenze, Italy
Robert Cort & Son, Ltd., Reading, England



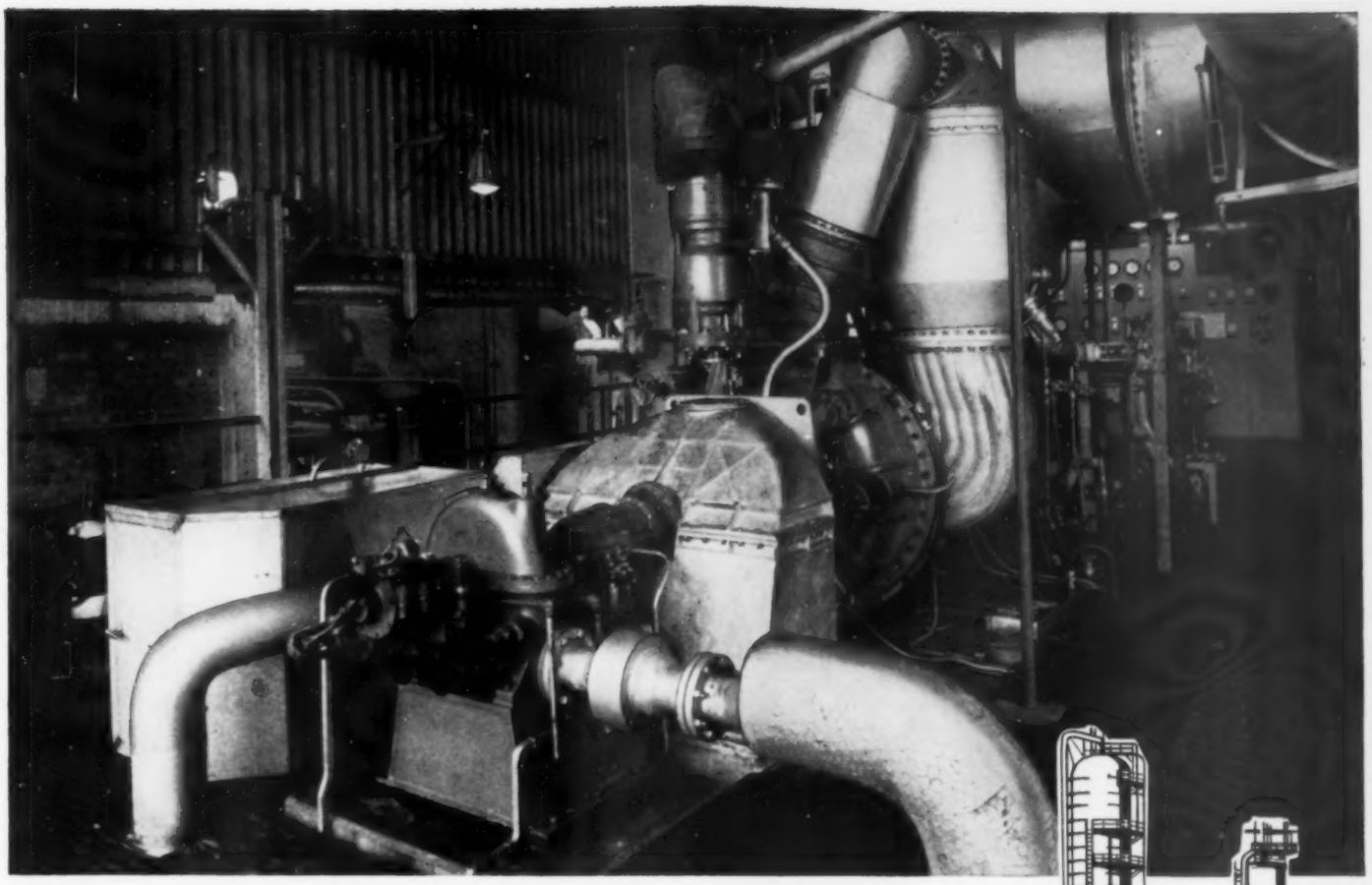
"The new Slagen refinery—the largest investment ever made in Norway by an American company—is a milestone in the development of our business in Northern Europe. As Trygve Lie said at its dedication: 'Without technical knowledge and experience from abroad, Norway never would have had an oil refinery.' Slagen thus stands as an impressive example of the kind of international co-operation that strengthens free nations."

—M. J. Rathbone, President

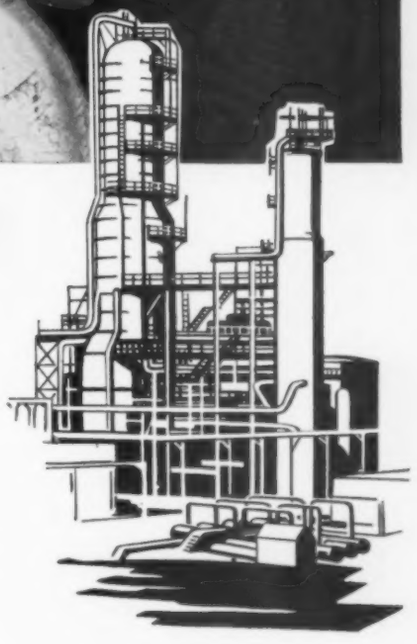
ESSO

Standard Oil Company (New Jersey)

(WHOSE PRINCIPAL U.S. OPERATING AFFILIATE IS HUMBLE OIL & REFINING COMPANY)



On duty 24 hours every day at Fawley



This 'ENGLISH ELECTRIC' gas turbine operates continuously for twenty-four hours every day in the Esso petro-chemical plant at Fawley Refinery—without a standby.

It is direct-coupled to a propylene refrigeration compressor on the butadiene extraction unit and delivers 2,625 h.p. to the compressor coupling at a shaft speed of 7,500 r.p.m. Waste heat from the turbine is used to raise 18,000 lb/hr of low pressure steam at 125 lb. gauge, for general refinery services.

Auxiliary equipment is flameproofed where necessary for working in a hazardous area.

'ENGLISH ELECTRIC'

LONG-LIFE

industrial gas turbines

from 2,300 h.p. (1,600 kW)

THE ENGLISH ELECTRIC COMPANY LIMITED, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2

Offices and representatives throughout the world

GT.7A

It takes extra hose strength and flexibility to give the fast, rugged service that modern cargo handling demands. As Japan's leading producer of tires and industrial rubber products, Bridgestone has the experience and technology to meet these demands with a line of high-pressure, high quality oil delivery hoses.

All Bridgestone hoses, for example, are manufactured of extra high tenacity rayon cord under a special Bridgestone patent. Oil can be handled at higher pressure, hose life is increased.

Bridgestone is the only rubber company in Asia with its own cord-weaving plant as well as a giant High Tensile processing machine that fills a 6-story building. With its experience in manufacturing oil delivery hoses from the yarn to the specially compounded rubber, it will pay to contact Bridgestone for your cargo-handling requirements.

BRIDGESTONE TIRE CO., LTD.

TOKYO, JAPAN

SALES OFFICE: NEDERLANDSCH VERKOOPKANTOOR VOOR CHEMISCHE PRODUCTEN N.V.
63, MAURITSKADE - AMSTERDAM - HOLLAND - P.O.B. 4038 - TELEPHONE 54322 - TELEX 12270 - TELEGR. CHEMICALS

NEW VERSATILE CATALYSTS FOR YOUR PLATINUM REFORMING OPERATIONS:

CYANAMID-KETJEN'S CK 300 RANGE

1/16" EXTRUDED PLATINUM REFORMING CATALYSTS

CK-303 - 0.3 Wt%
CK-306 - 0.6 Wt%
CK-307 - 0.7 Wt%

PLATINUM ON ALUMINA

with a high activity and stability maintenance, can be applied in regenerative, semi-cyclic or non-regenerative reforming operations, giving improved yields of a high octane gasoline component.

In employing these new catalysts, you will enjoy the technical service, so familiar to users of

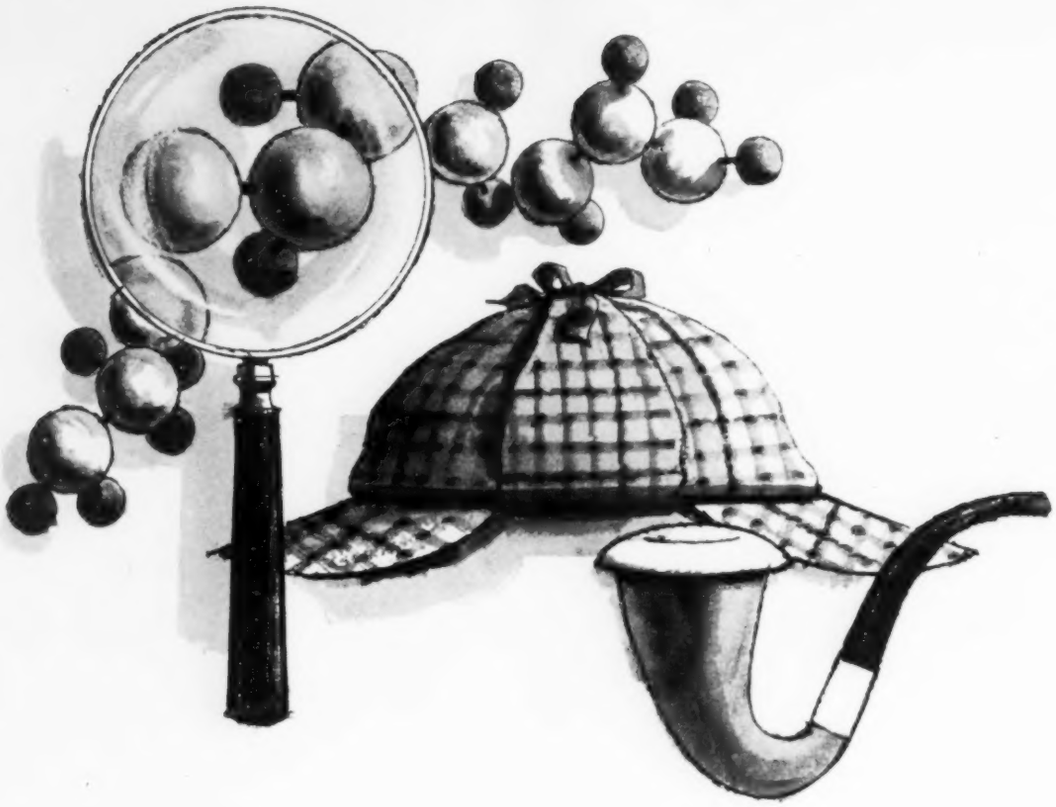
KETJEN'S other products for the oil industry:

CYANAMID-KETJEN, CK-103/106
PLATINUM REFORMING CATALYSTS.

KETJENCAT
FLUID CRACKING CATALYST

KETJENFORM
FLUID HYDROFORMING CATALYST

KETJENFINE
HYDRODESULPHURISATION CATALYST



THE CASE OF THE MISSING CARBON ATOMS

Sticky problem. Clearly not a case of theft. No evidence of foul play, either.

Whole thing started with "n-paraffins"—family of methane molecules. N-paraffins appear in crude oil and source rock—sediments in which oil was formed. Shifty, though; also crop up in rock which never harbored any oil. Very misleading to oil-hunters. How to tell one kind of rock from the other?

One piece of evidence to go on: N-paraffin molecules very careless about their make-up. Some have an *even* number of carbon atoms; others, an odd number. H-m-m-m. Any telltale ratio between the number of "even" and "odd" molecules?

One way to find out. Count the carbon atoms.

Ever count atoms? Easier said than done. Invisible, you know. Takes all kinds of latest, most advanced scientific techniques—fractionation, spectroscopy, radiocarbon dating, quick-freezing of cores. That sort of thing. Calls for first-rate scientists. Socony Mobil assigned job to task force of scientists under physicist Ellis Bray. Resourceful man, Bray. Persistent, too. Had to be—counted carbon atoms in *quadrillions* of n-paraffin molecules.

Job took lots of patience, correlation. This and a bit of shrewd deduction led science fellows right to the key. Simply this: If your count shows almost exactly as many molecules with *even* number of carbon atoms as with *odd* number, your molecules come from source rock. Good hunting ground for oil. But if "odd" molecules outnumber "even" by as little as 20 in 100, sediments not oil-bearing.

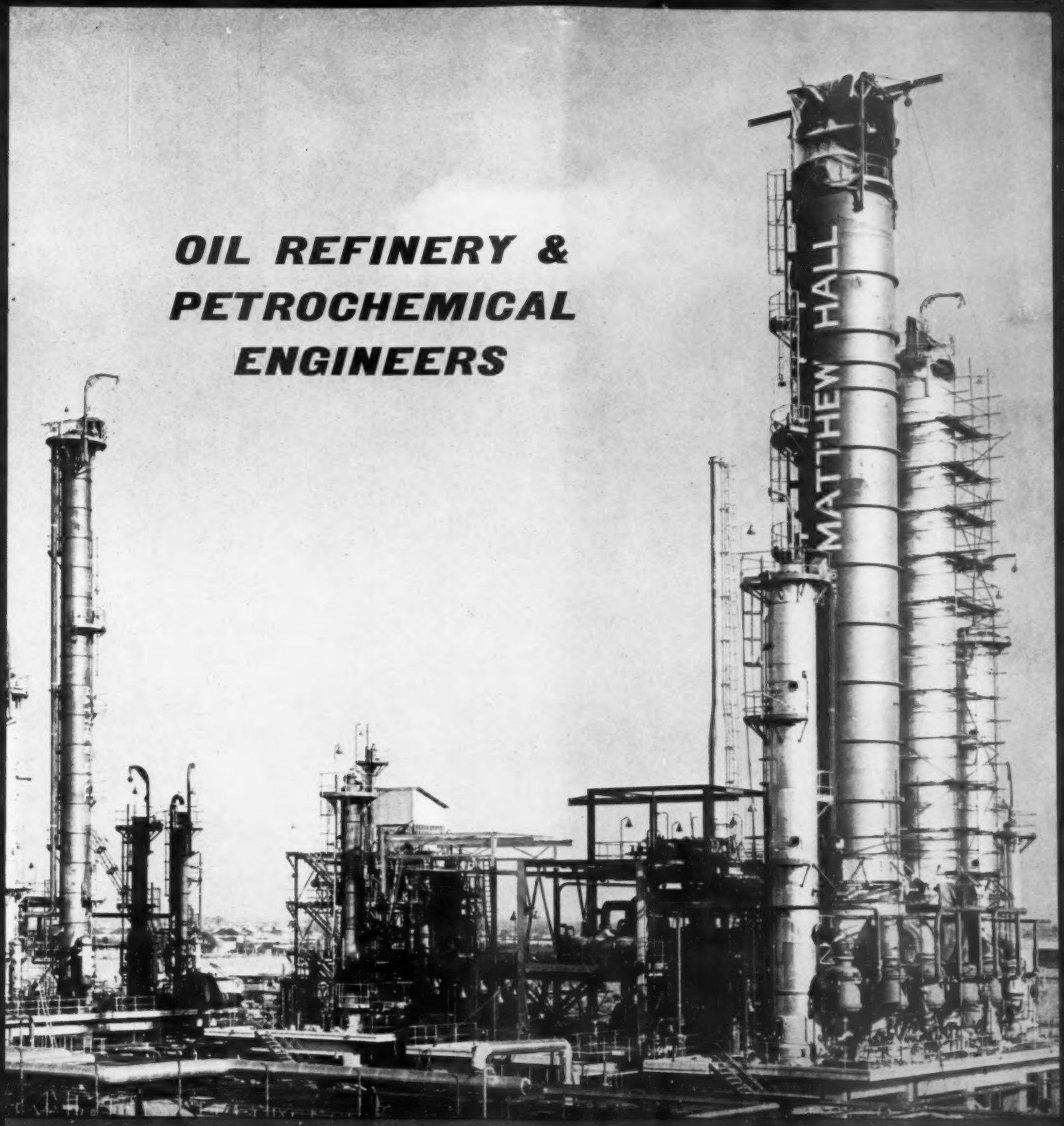
Elementary, of course. But good thing to apply to oil exploration. Can sometimes mean difference between success and failure. Big difference. Tantalizing, though, this discovery. Gives new clues to even deeper mystery—how oil formed in first place. Really *big, that one. Way it goes in this research thing.*

Lots of chaps working alongside Ellis Bray in Mobil's $25,000,000-a-year research program. Some 1,500 of them. Both sexes. Turn imagination into ideas, ideas into better products and processes. Clever.

Good thing, this probing frontiers of science. Not only for Mobil, but for everyone who does business with Mobil—customers, employees, licensees, investors.

SOCONY MOBIL OIL COMPANY, INC.
150 E. 42nd St., New York 17, N. Y.

Mobil



OIL REFINERY & PETROCHEMICAL ENGINEERS

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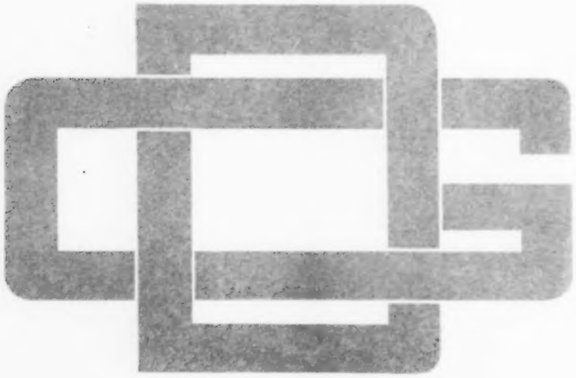
& CO. LTD.

MATTHEW HALL HOUSE, 101-108 TOTTENHAM COURT ROAD, LONDON, W.1. ENGLAND
MUSEUM 2676

GARDNER-DENVER 700 DRAWWORKS

Only Gardner-Denver, with its 100 years' experience in building every type of equipment for the oil field and industry, could have produced the completely new GD-700 drawworks. An eight speed, seven hundred horsepower unit, it is unparalleled in its depth class. The GD-700 design features short shafts that reduce bearing center distances . . . unit engineering of sprockets and chains to reduce wear . . . heavily reinforced side plates for rigid bearing support. Every component has been selected and engineered to produce a balanced drawworks that will operate with speed and low cost maintenance on drilling programs in the 5,000 to 10,000 foot range. □ The drawworks, transmission, controls, compound, engines and pump drives are mounted on a single main skid. When moving, only the auxiliary brake with its skid and the engines need be removed. Throughout the engineering of the GD-700, every drilling problem has been considered to assure the operator of a drawworks that is fast, safe and easy to move. □

The new Gardner-Denver 700 drawworks features: 330° wrap drum brakes □ Eight hoisting speeds and reverse □ Four rotary speeds and reverse □ Air controls for all rig operations □ All friction clutches mounted outboard □ Auxiliary positive Lo drum clutch □ Positive transmission clutches □ Centralized brake lube-center □ Hydromatic brake water level control at console □ Two package moving **GARDNER-DENVER**



© 1961 Gardner-Denver Company, Quincy, Illinois

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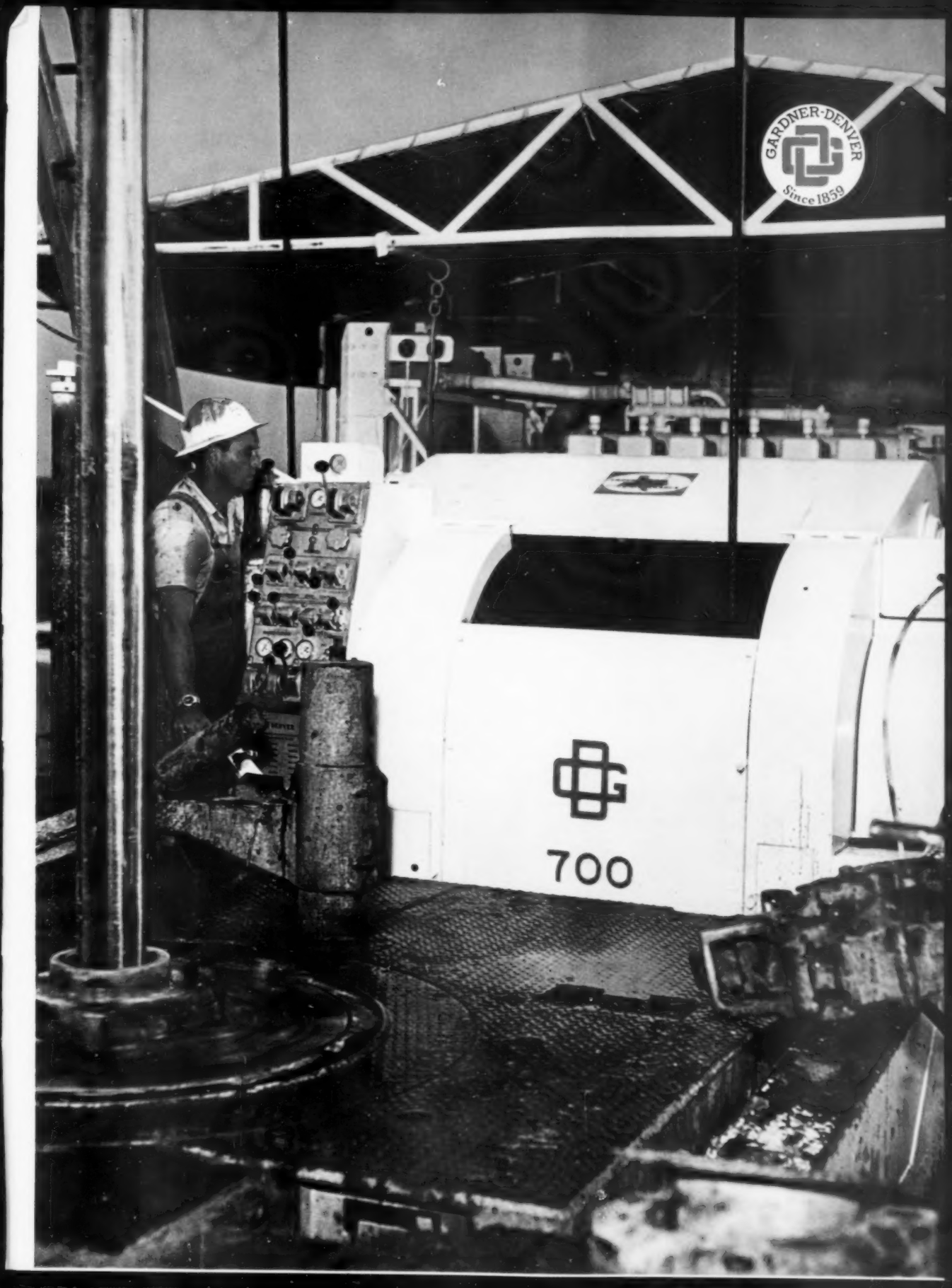

GARDNER-DENVER
Since 1859
700

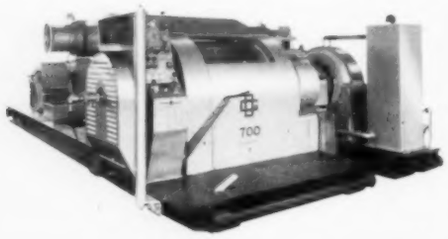
The GD-700 is a single skidded drawworks with all components mounted in line on the main skid section except the hydromatic brake and the engines. On location only these two elements need be rigged up to be ready for spudding-in.

The drum clutches and chains are mounted outboard where they may be easily serviced and inspected. Drum and brakes can be checked or inspected by removing the full width front panel. A unique tilting arrangement allows the driller's console to drop forward exposing valves and piping.

Trim-True
TRAVELING BLOCK 200 TON

Turbo-Lubricated
SWIVEL 200 TON

Turbo-Lubricated
ROTARY 17 1/2"



700

GARDNER-DENVER DRAWWORKS

Full line manufacturing from rotary table to mud pumps . . . Gardner-Denver drilling equipment has been designed as a matched team for greatest drilling efficiency. In addition to the drawworks, there is a swivel, block, rotary table, compressor and mud pump to match every drilling program.

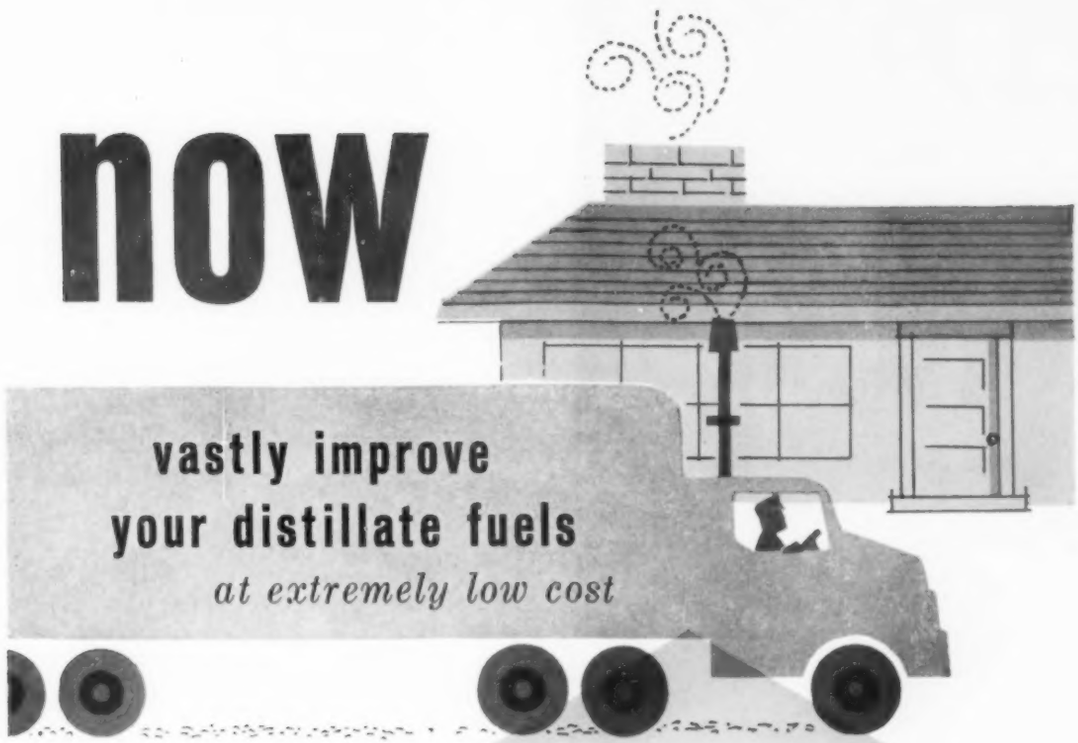
GARDNER-DENVER Since 1859 — 1 CENTURY

Gardner-Denver equipment combines imaginative engineering and modern technology with a century of experience.

GARDNER-DENVER

U. S. A. Gardner-Denver Company, Quincy, Illinois. Offices in principal U. S., Canadian and Mexican cities. Petroleum Products: Dallas, Texas. **CANADA** Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario. **INTERNATIONAL** Gardner-Denver International Division, 233 Broadway, New York 7, N. Y. Offices: Buenos Aires, Argentina; Artarmon, N. S. W., Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal.

now



vastly improve your distillate fuels

at extremely low cost

UOP INHIBITORS AND ADDITIVES FOR TREATMENT OF DISTILLATE FUELS

POLYFLO ™ *inhibitor-dispersants: Made in three formulations. Stabilize against thermal changes, color deterioration, sludge and deposit formation.*

DRIACIN ® *dispersant-additive: Specially formulated for unstable heating and diesel fuels. Limits growth of colloidal particles, prevents clogging of filters, formation of rust in storage tanks.*

UOP COPPER DEACTIVATORS : *Two grades—80% and 50% active ingredient. Prevent trace copper interfering with action of inhibitors. Minimize color and sediment deterioration.*

No one inhibitor or inhibitor-dispersant can fully and effectively protect *every type* of distillate fuel. Each needs its own proper inhibitor selection, which must be determined on the basis of a comprehensive analysis of the fuel to be treated.

In response to this need, UOP offers a unique and highly valuable service that includes determining your precise inhibitor needs, based upon inspection and study of your fuels. From this analysis, we will determine the best inhibitor or most effective inhibitor blend recommended for each type of fuel you market.

Use of the correct inhibitor or blend of inhibitors for a given distillate fuel assures maximum stability at minimum cost. Reduced concentration of inhibitors also minimizes water absorption.

Refiners with distillate fuel marketing problems will find this service a must!

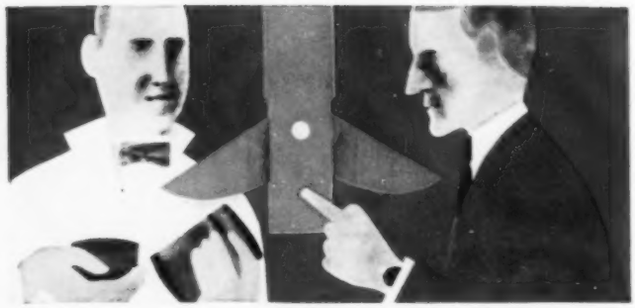
For our recommendations, send your distillate fuel samples to our Products Department—no obligation.

UNIVERSAL OIL PRODUCTS COMPANY
30 Algonquin Road
Des Plaines, Ill., U.S.A.

UOP

WHERE RESEARCH IS PLANNED WITH PROGRESS IN MIND

NEW UNDERGROUND SUPERHIGHWAY



Read how Gulf's Single-Point Entry Technique for fracturing gives up to 100 times the fracture capacity of conventional fracturing... offers you precision placement and increased drainage, too.

GULF

Perhaps you have used hydraulic fracturing successfully. It has helped many oilmen jump well production to 5 and 6 times the usual bbls./day.

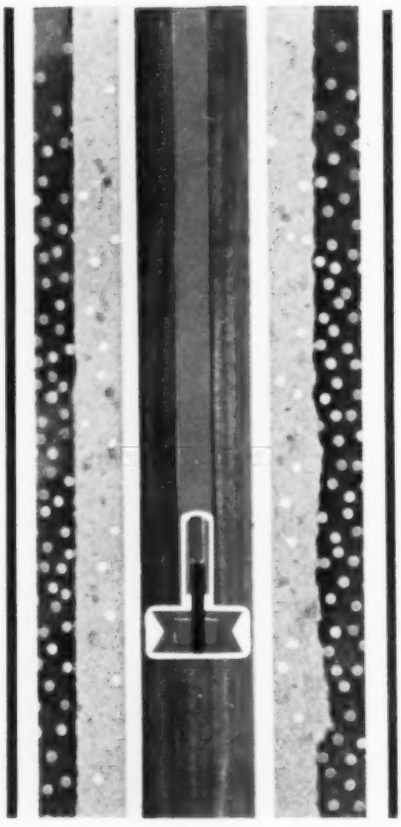
For a dozen years now, the basic technique of pumping fracturing fluids down the well bore under pressure to stimulate the flow of oil has been modified and improved.

But this conventional fracturing has its limitations. The industry has known this for a long time. At best, it is hit-or-miss. You can end up throwing several thousand dollars down a hole.

More often than not, you may be limiting your profits when your pay zone is thick or of low permeability.

It's also true that fracturing can give you disappointing results in a thin zone if the location of the fractures isn't right.

The scientific answer. Now, out of studies of fracturing at the Gulf Oil Corporation's Harmarville Research Center, comes an altogether new approach. One that all but takes the "miss" out of well stimulation.



For Gulf's development isn't just another technique. It is a precision system for fracturing. It replaces great gaps in our knowledge of fracturing with a painstakingly developed and tested body of scientific facts. It brings new ideas, new tools into play.

Our name for this precision system is Single-Point Entry Technique for fracturing.

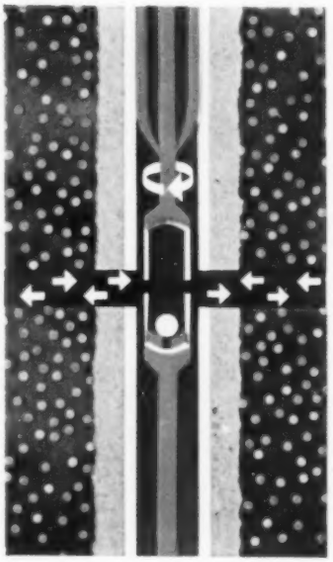
Up to 100 times the fracture capacity. Twenty-four service companies have already become Gulf licensees. In their hands, Single-Point Entry Technique for fracturing has already proved itself to be all our studies showed — and more.

One, it stimulates wells on jobs where conventional fracturing wouldn't even be worth a try. In itself, this characteristic moves

fracturing a long step ahead.

Two, Single-Point Entry Technique for fracturing usually outstimulates conventional fracturing techniques.

In both cases, Gulf's new system gives up to 100 times the fracture capacity of conventional fracturing. It has actually pushed productivity beyond the most hopeful expectations. In some cases, 20, 40, 60 times.



This system gives you all 3. Why does Gulf's new system give so much more than conventional fracturing? Because no conventional technique offers this scientific, systematic, 3-step approach: (1) precision fracture placement, (2) high fracture capacity and (3) an adequate reservoir drainage system.

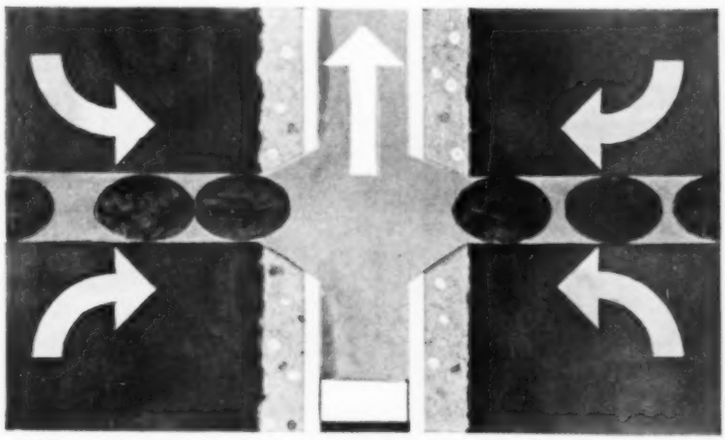
Now Single-Point Entry Technique for fracturing is available to boost your well flow levels. To pay you a sizeable number of bonus benefits as well. To improve reservoir drainage, for one. To lessen pressure drawdown. To lower gas-oil ratios. To minimize water coning. To make work-overs simpler.

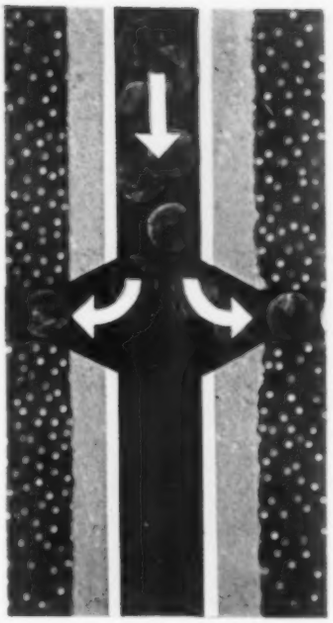
"Superhighway" for oil. No more hope-for-the-best fracture location. In Single-Point Entry Technique for fracturing, any one of three tools cuts the notch precisely where reservoir study says it should.

These tools include a mechanical cutter, a hydraulic notcher which jets an abrasive stream, and a ring charge for use in explosive notching.

No more helter-skelter fractures with Single-Point Entry Technique for fracturing. In their place, a single large "superhighway," extended deep into your pay zone.

And no more inadequate drainage. Your large fracture area and carefully prescribed propping agents assure that.





Just contact these licensees. It's so easy to have the Single-Point Entry Technique for fracturing custom-fitted to your well-stimulation needs. Simply contact any one of these Gulf licensees:

Acid Engineers, Inc. • Acme Tool, Incorporated • Axelson-Garrett Division, U. S. Industries, Inc. • Baash-Ross Division, Joy Manufacturing Company • Baker Oil Tools, Inc. • BJ Service, Inc. • Cardinal Chemical, Inc. • Chemical Sand Services, Inc. • Dowell Division, The Dow Chemical Company • Eline Acid Company (The) • Eskimo Fracturing & Well Servicing Ltd. • GO Oil Well Services, Inc. • GO-Western Service • Grant Oil Tool Company • Halliburton Company • Independent Oil Well Frac Company • Lane-Wells Company • Oklahoma Fracturing Services, Inc. • Producers Chemical Company • Sand Survey, Inc. • Servco Company (The) • Western Company (The) • Wireline, Inc. • Worth Well Surveys, Inc.

THE GREATEST AMOUNT OF HORSEPOWER EVER ASSEMBLED AT A WELL . . .

Over 12,500 hydraulic horsepower was needed, and Halliburton delivered... fast! In an emergency or a routine cementing, fracturing or acidizing operation, there has never been a job too big or too small for Halliburton.

Dependable power equipment is such a vital part of a successful service job we don't rely on outside sources to meet our rigid standards... we design and build our own. Operators the world over have come to rely on this superior equipment and the men who operate it whether they need one truck or many for the job to be done.

When dependable horsepower is called for, you can count on Halliburton to deliver... we've been doing so for over 35 years.

Halliburton COMPANY
DUNCAN, OKLAHOMA

Better harbor facilities needed . . . now!

Port development and improvement in the Western Hemisphere to accommodate the large tankers of today—and the even larger tankers of the future—is falling behind the Eastern Hemisphere, especially in the United States as compared with Europe and the Middle East.

Some rather significant data emphasizing this problem were brought out at the 1961 Tanker Conference of the American Petroleum Institute by two Standard Oil (New Jersey) marine transportation men: Capt. Milton Breece, manager of the operating department of Humble Oil's marine division; and Capt. James G. Moffitt, operating superintendent of Esso Tankers, Inc.

Most shipping experts will agree with the Jersey men that tanker sizes will continue to increase. Practically all tankers constructed during the last 10 to 15 years have ranged from 25,000 to 85,000 deadweight tons, with several running over 100,000 dwt. And, of all new tankers under construction or on order throughout the world as of the first of 1961, some 20% are 50,000 dwt or greater, including two super giants of 130,000 dwt scheduled for delivery in Japan next year and 1963. Tankers being built in United States yards alone average 56,000 dwt.

Seriousness of the problem is seen in the fact that out of some 200-plus marine oil terminals in the various USA coasts, only about 10% would be usable by Humble for vessels over 40,000 dwt. Shipowners require sufficient bottom clearance, enough maneuvering room, and adequate berthing facilities. The first two of these are the prime responsibility of the local or national governments involved, and the third is up to the terminal owner.

Many Eastern Hemisphere ports are already capable of handling the supertankers. Six of them can accommodate 100,000 or 104,000 dwt tankers—Finnart and Milford Haven in the United Kingdom; Slagen in Norway; Sidon, Lebanon; Kharg Island; Iran; and Mina al Ahmadi, Kuwait. Others in the UK, France, Germany, Netherlands, Syria, and Saudi Arabia have capabilities ranging from 65,000 to 85,000 dwt tankers.

At ports outside the USA, there have been several examples of success in projects undertaken by local and federal governmental agencies to promote world trade by improved harbor facilities. Among the most notable must be included: Rotterdam, with its existing three petroleum harbors and a fourth (Europort) presently under construction; Wilhelmshaven; the Suez Canal; Lavera the port of Marseilles; Bougie in Algeria; Antwerp; and Hamburg. In all these cases, long range plans were carefully worked out, and then followed by prompt action and construction. There was also close technical cooperation among the groups concerned. Further, study continues to ensure proper development to meet future needs.

In the United States, a major problem has been the many steps which must be taken to secure channel improvements—steps which require four to five years before any actual work on a project can start. First, a resolution must be introduced in Congress authorizing the Corps of Engineers to hold a public hearing at which all interested parties submit their recommendations, backed by economic justification. When approved by the District Engineer, the project is passed to the Division Engineer, thence to the office of the Chief of Army Engineers in Washington. After this, the project is included in a Rivers and Harbors Bill and submitted to Congress for authorization. Following approval of such a bill by Congress, no work can commence until funds are provided in an appropriations bill, which also must gain approval by Congress.

Among the presently authorized deepwater projects in various stages of completion, only about one-third indicate a proposed main channel depth capable of accomodating a fully loaded vessel larger than 38,000 dwt. Many other proposed projects for further channel improvement have gone through public hearings, surveys, and partial government action, for such ports and areas as Portland, Me.; New York-New Jersey; the Delaware River valley, Baltimore, New Orleans, and Houston. Action has been slow, or in some instances at a standstill.

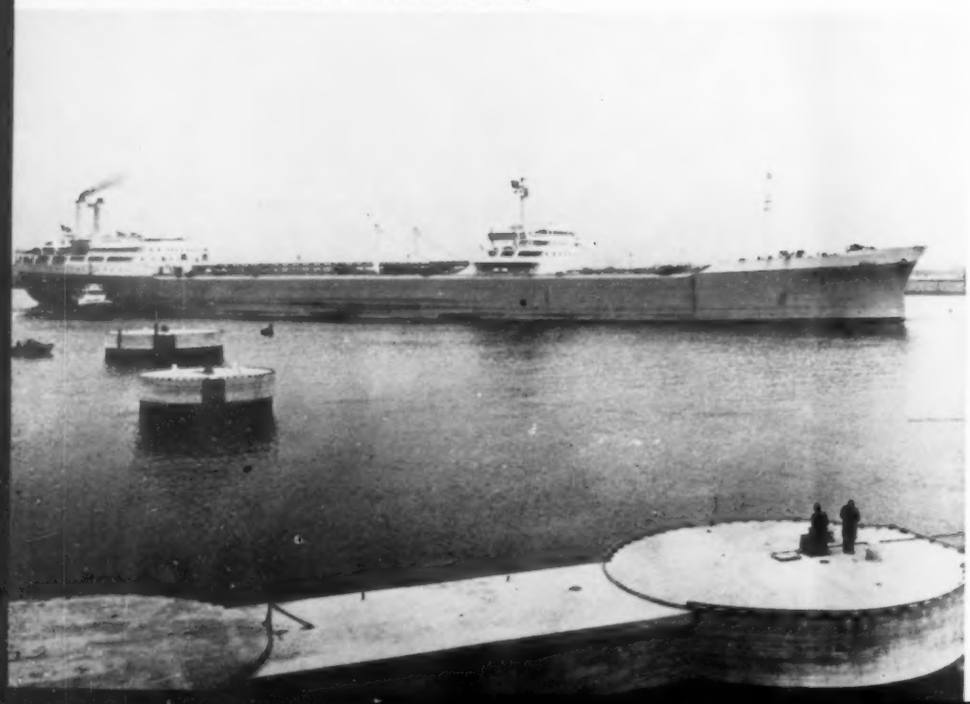
A major drawback in the United States is the excessive time lag between an initial recommendation and the final completion of a harbor project—almost ten years. Until, and unless, this time interval is reduced to a more reasonable period, USA facilities for tanker transportation of oil will simply not keep pace with those in the Eastern Hemisphere.

Shell's "Serenia," a 66,790 dwt tanker is the new flagship of the Group's British Fleet. A Shell photo.

World tanker fleet growth rate continues to decline

Total tonnage rises 1.2% in first half of 1961. New construction shows sharp drop. Two thirds of ships still on order are of 40,000 dwt or greater. Liberia's lead as world's largest fleet continues to narrow

France's largest merchant vessel, the 74,000 dwt Shell tanker "Sitala" went into service last January



SIX MAJOR POINTS emerge from a study of the world-wide tanker situation as of mid-1961.

(1) The world tonnage total continues to climb, but at gradually dwindling growth rates.

(2) Liberia remains the country of registration with the largest fleet, although its total tonnage is decreasing, and that of the other major fleets is growing.

(3) New construction has dropped considerably from year-ago levels. Largest share of new construction is taking place in Great Britain, and that country is also taking the major share of new vessels.

(4) Bigger tankers continue to dominate new building. Ships of 40,000 dwt or more represent two-thirds of the vessels presently on order.

(5) Outlook is for a 22.2% rise in the world total commercial fleet by the end of 1965—a yearly growth rate averaging 4.1%, significantly less than the 11.5% annual rate from 1956-1960.

Esso Petroleum's new 41,400 dwt, Diesel powered "Atalante," delivered in August at Malmo, Sweden

(6) Some tanker surplus can be expected to continue during the coming five years, though this surplus could reach a point in the near future where seasonal tightness in the market may be anticipated.

Statistical data on which this article is based have come from the most recent reports and studies of such firms as Lloyd's Register of Shipping, Davies & Newman, Ltd.; and Sun Oil Co.

World Total: As of July 1, oil tankers of 500 gross tons and over totalled 67,171,118 dwt, an increase of 776,008 (1.2%) over January 1, when tonnage was 66,395,110. The increase in the previous six months had been 1,256,017 (1.9%), from a July 1, 1960, level of 65,130,093. And the rise a year ago, during the first half of 1960, had been 1,758,478, or 2.8%.

During the first half of this year, 55 new vessels of 7,000 dwt or more were launched for about 1,962,000 dwt. Thirty-seven of these ships were 30,000 dwt or more, and the average dwt of all tankers launched was about 35,675. By comparison, launchings in the first half of last year totalled 2,842,000 dwt (83 new ships), of which 52 were 30,000 dwt or more, and with an average dwt of just over 34,200.

Sales of tankers for breaking up in the first half of 1961 came to 1,022,000 tons (82 vessels). In addition, a further 15 ships of about 255,000 dwt have been sold for conversion. Thus, altogether, some 97 vessels (including 16 T2 tankers) totalling 1,277,000 dwt have been moved to scrapping or conversion, as compared with 86 (including 23 T2's) of 1,153,000 dwt total during the first half of last year.

Tonnage of the individual fleets is detailed in Table 1. Although Liberia still has the largest fleet, its total decreased and its lead over the United Kingdom is now only 0.8 percentage points, in terms of share of the world total tonnage. A year ago, Liberia led the UK by 1.6 percentage points.

The Norwegian fleet showed the largest increase, a rise of about 265,000 dwt. Japan's increase of 227,000 dwt was second largest, and Greece at 224,000 dwt was a close third. The Dutch fleet rose by almost 100,000 dwt, while Italy and France increased by 80,000 and 65,000 respectively. The British total went up only some 18,000 tons, due to the sale for scrapping or conversion of about 428,000 dwt since January 1.

Reductions in tonnage occurred in five fleets: as follows: Liberia, 151,000 dwt; Panama, 184,000; Sweden, 66,000; Denmark, 34,000; and Portugal, 23,000.

Age distribution: Vessels built during and before World War II and still in operation continued to decline in ratio to those built since 1945. In terms of dwt, pre-war tonnage (for vessels of 500 tons gross and over) now represents 3.5% of the world fleet; war-built tonnage is 12.7%; tonnage built in the decade following the war is 33.2%; and that built since the end of 1955 is 50.6%. A year ago, the percentages—in the same sequence as above—were 4.9, 15.2, 35.4, and 44.5. The relative positions of the four largest flag fleets at present is shown in Table 2.

Total tonnage of new building contracts has changed little since the first of this year, and it remains at about 13.6 million dwt (see Table 3). Swedish yards have the largest share of the orders, 17.4%. Japan is close behind with 17.3%. British yards hold 14.6%, and German 14.4%. These data are all based on vessels of 500 tons gross and over, as reported by Davies & Newman.

Large tankers still dominate new building. Of the 308 ships still on order, two-thirds are 40,000 dwt and greater. Another 15% are between 30,000 and 40,000. Also, one result of scrapping and conversion has been a further net reduction by about 83 in the number of vessels in service under 20,000 dwt (see Table 4).

A report on world tanker construction at the end of the first six months of 1961 was also given in Lloyd's Register Shipbuilding Return for the quarter ended June 30 (see Table 5). These figures are in gross tonnage and number of vessels, and are for ships of 100 tons gross and over. The report shows 243 tankers of 3,601,153 tons gross to be under construction as of June 30, 1961, down 17% from the tonnage a year ago. Of this year's total, 82 are steamships of 2,411,848 tons, and 161 are motorships of 1,189,305 tons.

Prospects for future growth—to end of 1965—were reported by James S. Cross, Sun

TABLE 1—World Tanker Tonnage
(500 tons gross and over)

Country of registration	July 1, 1961 1000 dwt	July 1, 1961 per cent	Jan. 1, 1961 1000 dwt	Jan. 1, 1961 per cent	July 1, 1960 1000 dwt	July 1, 1960 per cent
Liberia	11,502	17.1	11,653	17.6	12,007	18.4
U.K.	10,972	16.3	10,954	16.5	10,928	16.8
Norway	10,202	15.2	9,937	15.0	9,663	14.8
USA*	7,000	10.4	6,992	10.5	6,906	10.6
Panama	3,482	5.2	3,667	5.5	3,868	5.9
France	3,227	4.8	3,162	4.8	2,992	4.6
Italy	2,951	4.4	2,871	4.3	2,778	4.3
Japan	2,628	3.9	2,401	3.6	2,267	3.5
Sweden	2,535	3.8	2,601	3.9	2,443	3.8
Greece	2,221	3.3	2,097	3.2	1,525	2.3
Netherlands	2,083	3.1	1,984	3.0	2,215	3.4
Denmark	1,378	2.1	1,412	2.1	1,381	2.1
Russia	1,236	1.8	1,108	1.7	1,034	1.6
Germany	1,148	1.7	1,117	1.7	1,069	1.6
Spain	766	1.1	702	1.1	641	1.0
Argentina	687	1.0	573	0.9	452	0.7
Brazil	545	0.8	534	0.8	503	0.8
Venezuela	382	0.6	380	0.6	407	0.6
Finland	361	0.5	361	0.5	261	0.4
Belgium	260	0.4	286	0.4	286	0.4
Portugal	191	0.3	214	0.3	186	0.3
Mexico	179	0.3	179	0.3	184	0.3
Others	1,233	1.9	1,211	1.8	1,134	1.7
Totals	67,171		66,395		65,130	

*Commercial fleet only.
Source: Davies & Newman, Ltd.

TABLE 2—Leading Tanker Fleets by Age Groups
(Percent of total dwt, for vessels 500 gross tons and over)

Fleet	Pre-war	War-built	1946–55	1956–61
Liberian	1.5	7.8	28.9	61.8
British	2.1	7.5	38.3	62.1
Norwegian	2.7	3.0	47.5	46.8
U.S.A.	3.1	52.3	17.6	27.0

Source: Davies & Newman, Ltd.

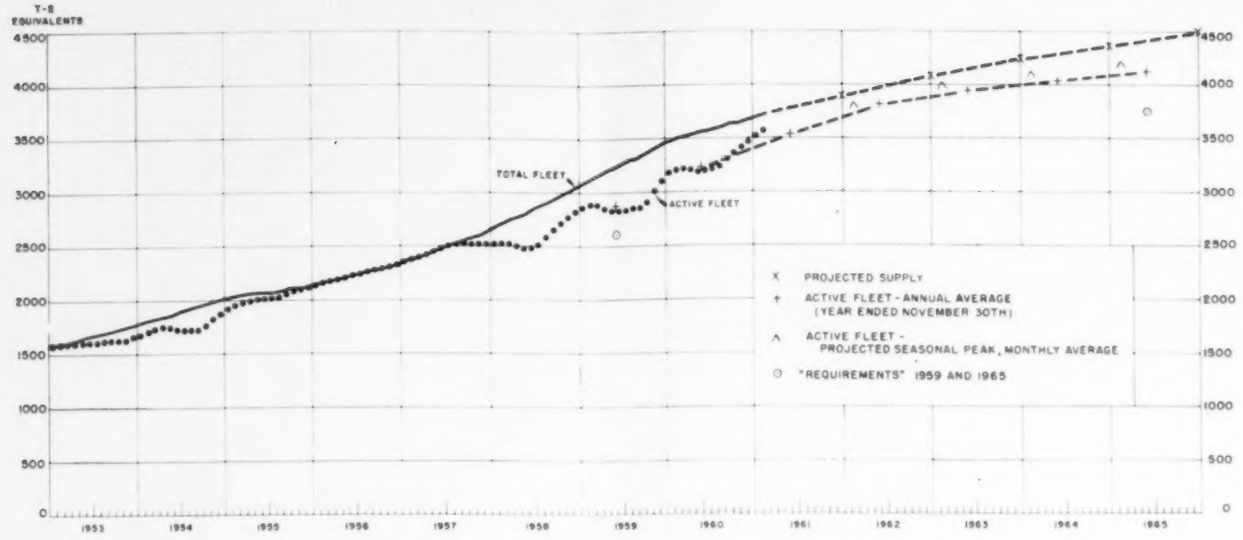


Fig. 1—Total world commercial tanker fleet activity and supply (tankers of 6,000 dwt and over)

TABLE 3—New Tanker Building Contracted
(In 1,000 dwt, as of July 1, 1961)

	Tonnage being constructed in											
For Flag of	Denmark	France	Germany	Gt. Brit.	Italy	Japan	Netherl'ds	Norway	Sweden	USA	Others	Totals
Norway	220.00	192.00	474.00	134.00	—	—	—	1,283.50	1,115.00	—	—	3,418.50
UK	—	122.60	538.50	1,793.50	—	193.50	175.50	—	542.25	—	—	3,365.85
Japan	—	—	—	—	—	825.50	—	—	—	—	—	825.50
Sweden	—	226.80	—	—	—	—	—	—	377.00	—	—	603.80
France	—	472.50	—	—	—	—	—	—	—	—	—	472.50
USA	—	—	—	—	—	—	—	—	—	—	—	467.00
Germany	—	—	411.00	—	—	—	—	—	—	467.00	—	411.00
Denmark	181.75	—	—	—	—	19.50	—	—	—	—	—	201.25
Italy	—	—	—	—	178.00	—	—	—	—	—	—	178.00
Netherlands	—	—	—	—	—	—	130.50	—	—	—	—	130.50
Others	308.00	121.50	527.00	64.20	26.00	1,320.50	416.50	—	337.00	—	399.00	3,519.70
TOTALS	709.75	1,135.40	1,950.50	1,991.70	204.00	2,359.00	722.50	1,283.50	2,371.25	467.00	399.00	13,593.60

Oil Co., at the 1961 Tanker Conference of the American Petroleum Institute.

The expectation is a 22.2% rise, for an average annual growth rate of 4.1%, considerably below the 11.5% average annual rate experienced during the last five years. The Sun Oil man's figures are for the commercial fleet only, and are all given in terms of T2 equivalents.

At the end of 1960, the world total commercial fleet consisted of 3,680 T2 equivalents. A T2 equivalent is based on a tanker of 16,765 dwt and sailing at 14.5 knots. By the end of 1965, this will have increased to 4,498 (1,275 added and 457 deleted). On the basis of current scrappage rates, about 131 will be removed this year; and on the basis of present deliveries, 327 will be added. Both scrappage and delivery rates are expected to decline thereafter (see Table 6). During the same period, the USA commercial fleet is expected to rise from 429 to 447 T2's, an average annual rate of only 0.7%.

This analysis is based upon the following assumptions:

(1) Additions to foreign fleet will include all ships under construction or on order at end-1960, plus further deliveries equivalent to 250 T2's from orders not now on the books. For the USA fleet, additions will consist of 35 T2's underway presently, plus 40 not yet ordered.

(2) Scrappage of foreign flag tankers will be equivalent to 318 T2's, based on the following estimates. Portions of the end-1960 fleet which will be scrapped during the next five years are: (a) 90% of pre-World War II construction, (b) 67% of war-built ships, and (c) 20% of 1946-50 construction. This corresponds roughly to a 20-yr median age at scrappage.

(3) Conversions of foreign T2 equivalents will be 64, based on the ratio of scrappage to conversions of 5 to 1 that has prevailed in foreign fleets for the past four years.

(4) Scrappage and conversions of USA fleet will total 53 T2 equivalents, of which two-thirds will be scrapped and one-third converted. It is expected that almost all the present US carrying capacity built prior to 1942 will be either scrapped or converted, while one-fifth of the war-time construction will be deleted, thus corresponding roughly to a 25-yr median age at scrapping.

(5) Transfers from foreign fleet into foreign fleet will be balanced, as will those from and into the USA fleet.

The world growth rate in tanker requirements after 1962 is very likely to taper off, Mr. Cross said, for the following reasons:

(1) Growth rate in European petroleum demand will tend to decrease, especially after 1962, because of increasing competition from natural gas, stabilization of the coal industry, and saturation of those markets most easily penetrated.

(2) By 1953, the Sahara will become a major crude source for western Europe, thus

TABLE 4—World Tanker Fleet Distribution by Tonnage and by Propulsion
(No. of ships 500 gross tons and over, July 1, 1961)

	In service and launched			Building and contracted		
Dwt.	steam	diesel	total	steam	diesel	total
7,000– 9,999	35	57	92	0	5	5
10,000–17,999	457	726	1,183	1	7	8
18,000–19,999	188	321	509	8	22	30
20,000–24,999	116	148	264	0	8	8
25,000–29,999	156	62	218	6	4	10
30,000–34,999	224	57	281	19	7	26
35,000–39,999	123	12	135	9	12	21
40,000–49,999	174	18	192	68	34	102
50,000–plus	45	3	48	74	24	98
Totals	1,518	1,404	2,922	185	123	308

TABLE 5—World Tanker Construction
(As of June 30, 1961. Vessels of 100 gross tons and over)

Country of Build	No.	Gross tons
Great Brit. & N. Ireland	40	782,963
Sweden	22	528,695
Japan	49	407,022
West Germany	30	307,634
Netherlands	9	256,699
France	9	231,550
USA	6	184,650
Norway	15	181,579
Italy	11	179,699
Denmark	7	168,640
Spain	10	106,086
Belgium	2	61,300
Poland	10	59,098
Yugoslavia	5	44,550
Other Brit. Commonw'lth	3	35,550
Portugal	2	23,560
Finland	6	18,220
Greece	2	16,478
Taiwan	2	4,800
Argentina	1	1,500
Turkey	2	880
Totals	243	3,601,153
Totals, year ago		4,358,613

Intended Flag	No.	Gross tons
Great Brit. & N. Ireland	52	1,180,928
Norway	23	390,665
Liberia	9	294,937
Japan	44	274,740
USA	8	260,405
France	7	185,200
Italy	10	162,699
Netherlands	11	156,999
Sweden	7	110,499
Panama	4	106,950
Spain	9	105,000
Denmark	4	65,840
Yugoslavia	5	44,550
West Germany	15	42,280
Greece	3	32,827
Portugal	2	23,560
Israel	1	21,400
Canada	2	14,550
Turkey	3	14,180
Taiwan	2	4,800
Finland	1	1,600
Argentina	1	1,500
Paraguay	1	1,086
Other Brit. Commonw'lth	1	190
Other countries	18	103,818
Totals	243	3,601,153
Total for flag of country of build	167	2,068,228
Total for flag of other countries	76	1,532,925

The "Esso Boston," a 47,400-dwt ship, is the second of two supertankers of this class constructed for Humble Oil by Newport News Shipbuilding and Dry Dock Co.

reducing the growth in crude shipments to western Europe from the longer Middle East and Caribbean runs.

(3) The completions of new pipelines will lessen tanker requirement growth. For example, the line from Marseille to Strasbourg which is scheduled for completion in late 1962 will decrease tanker movements into northern Europe. Imports into eastern Canada could level off, or decline, if decisions are reached to build more crude-carrying pipelines between western and eastern Canada. And, the possibility of new pipelines connecting Russian zones with western Europe could reduce shipments by tanker from the Black Sea to Europe.

(4) Several South American countries, particularly Argentina, will become increasingly self-sufficient with respect to energy needs.

Table 7 shows 1959 and 1965 estimated movements of oil among some of the major areas of the world as well as estimated T2 requirements. It was developed on the basis of data reported by Mr. Cross. The T2 requirements were computed by dividing area shipments by the volume one T2 operating in a given trade can transport in one year, Mr. Cross said.

Development of final figures on the *active* commercial fleet and those on the *total* fleet involve a number of further adjustments and modifications, according to the Sun Oil man. The chart in Fig. 1 traces the changes in the total and the active fleets with projections to 1965, and indicates the requirements for 1959 and 1965, for tankers of 6,000 dwt and over, and in T2 equivalents.

The tight market during the Suez crisis is clearly indicated in the curves through 1956 and 1957. Since then, there has been a sizable surplus which has been reduced only in the past year.

The triangular marks representing anticipated seasonal peaks show that a balanced market is not expected. However, Mr. Cross

TABLE 6—Commercial Petroleum Tanker Fleet, 1961-65
(Figures in T2 Equivalent. Tankers 6,000 dwt and over)

	USA Fleet	non-USA	World Total
Fleet—12/31/60	429	3,251	3,680
Additions — 1961	17	310	327
Deletions — 1961	11	120	131
Net change	6 (1.4)*	190 (5.8)	196 (5.3)
Fleet—12/31/61	435	3,441	3,876
Additions — 1962	11	275	286
Deletions — 1962	9	100	109
Net change	2 (0.5)	175 (5.1)	177 (4.6)
Fleet—12/31/62	437	3,616	4,053
Additions — 1963	12	230	242
Deletions — 1963	10	80	90
Net change	2 (0.5)	150 (4.1)	152 (3.8)
Fleet—12/31/63	439	3,766	4,205
Additions — 1964	15	195	210
Deletions — 1964	13	55	68
Net change	2 (0.5)	140 (3.7)	142 (3.4)
Fleet—12/31/64	441	3,906	4,347
Additions — 1965	20	190	210
Deletions — 1965	14	45	59
Net change	6 (1.4)	145 (3.7)	151 (3.5)
Fleet—12/31/65	447	4,051	4,498
Five-yr change	18 (4.2)	800 (24.6)	818 (22.2)
Average annual change	3.6 (0.7)	160 (4.5)	163.6 (4.1)

*Figures in parentheses are percentage increases.

TABLE 7—Estimated Oil Movements and Tanker Requirements, 1959 and 1965
(Trade in 1,000 b/d, and tankers in T2 equivalents)

	1959		1965	
Movements	Trade	T2's	Trade	T2's
US Gulf Coast to East Coast	1,829.2	220.5	2,052.0	253.3
Carib. to US East Coast	1,230.1	145.9	1,395.2	165.5
Carib. to Canada	270.3	38.1	388.2	54.7
Carib. to Europe	575.0	158.3	597.3	164.4
N. & West Africa to Europe	70.9	6.7	1,303.0	118.7
Mid-East to US East Coast	237.5	118.8	286.1	144.2
Mid-East to US West Coast	99.1	82.6	113.4	94.5
Mid-East to Europe	2,568.9	875.7	3,234.5	1,162.5
Mid-East to So. Asia and Indonesia	228.6	45.5	394.7	76.4
Mid-East to Far East	361.2	142.7	984.5	389.0
Mid-East to Australia	146.0	75.3	296.3	152.9
All others	2,771.0	699.6	3,816.0	984.7
WORLD TOTALS	10,387.8	2,609.7	14,891.2	3,760.8

The 46,692 dwt "Mobil Meridian" is largest Socony-owned tanker to be used in U.S. domestic coastwise trade

pointed out that a relatively small error in either projection or short-run considerations, such as a cyclical upswing or an unusually cold winter, could result in a temporarily tight market.

Among the interesting new tankers launched during the past year were Shell's 65,000 dwt "Serenia," and 74,000 dwt "Sitala"; Esso Petroleum's 77,000 dwt "Esso Pembrokeshire," and its chartered 41,400 dwt "Atalante"; Socony-Mobil's 46,692 dwt "Mobil Meridian"; and Mitsui & Co.'s 3,656 dwt "Santai Maru."

The "Serenia," built for Shell Tankers Ltd. by Vickers-Armstrongs (Shipbuilders) Ltd. Newcastle-upon-Tyne yards, is the new flagship of Shell Tankers' British Fleet.

This is a size of tanker of which a good many more are likely to be built, as it is well suited to crude oil service from the Persian Gulf to northern Europe.

It is also a size of interest technically because the power (about 22,000 shp) that it requires for an economic speed is about at the upper limit of the new generation of marine Diesel engines, and is therefore a new field of competition between steam turbine and Diesel.

The steam turbine generally has remained the first choice of British owners for this and for much lower powers of tanker engines, primarily because of the ready availability of steam for tank cleaning.

Steam conditions selected were 600 psi and 900 F, and the reasons behind this choice are of interest technically and economically. Shell pointed out that for machinery of 22,000 shp, the choice of pressure was between 600 and 900, and of temperature it fell between 850 and 1,100 F. The lower limits were suggested by the proved performance of many steam turbine installations in the past decade or so. The upper limits were more difficult to assess.

More severe conditions than those chosen would of course have contributed to fuel economy. For example, raising temperature to 950 F with the pressure still at 600 psi would have improved the fuel rate by about 2%, or 2½ ton/day of fuel at about $17/ton. Using conditions of 850 F and 850 psi would have yielded about one ton/day fuel saving, and a combination of 950 F and 850 psi would have reduced fuel rate by 5 ton/day. This would represent a saving of approximately $27,000 per year, since a tanker of this type spends some 320 days a year at sea.

Balanced against such incremental fuel savings, as Shell saw it, was the potentiality of increased maintenance and reduced reliability. The higher pressures and temperatures could lead to leakage problems, corrosive attack, etc. The total cost of a breakdown at sea can easily outweigh many years of slight savings in fuel costs, Shell said.

The 850-ft "Sitala," which went into service in January, is the first of two 74,000 tonners ordered by Soc. Shell Maritime from the Chantiers de l'Atlantique, St. Nazaire. She is France's largest merchant vessel and the largest tanker owned by a company in the Royal Dutch/Shell Group. Engines of 22,000 hp driving a single, five-blade, 20-ft screw give her a service speed of about 16½ knots.

In a test of dock facilities at Europoort, the new extension of Rotterdam harbor, the "Sitala" brought 34,000 tons of crude from Banias in Syria, via Le Havre, which was discharged in less than nine hours into a Shell Nederland storage tank at the port.

The "Esso Pembrokeshire," launched at Bremen in June, is the first of five new 77,000 dwt tankers on order for Esso Petroleum Co. Ltd., and is expected to go into service between the Middle East and Esso refineries in the UK before the end of this year. She will have the largest displacement—100,000 tons—of any ship built in Europe.

Esso Petroleum recently chartered the 41,400 dwt "Atalante," which is powered by a 12-cylinder, turbo-charged Kockum-MAN, Diesel engine developing 16,200 bhp at 115 rpm. She was delivered in August by Kockums Mekaniska Verkstad of Malmo, Sweden, the eighth vessel of her class, but the first to be Diesel propelled. On trials fully loaded, the "Atalante" attained a mean speed of 17.38 knots.

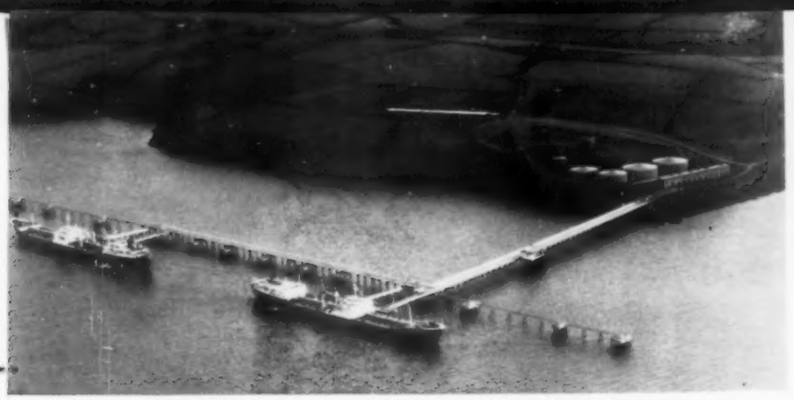
Socony-Mobil Oil Co.'s new 46,692 dwt "Mobil Meridian" will be the largest company tanker to be employed in U.S. domestic coastwise trade. With a cargo capacity of 395,321 bbl, she is 736 ft long, built by the Bethlehem Steel Co. Shipbuilding Division at Sparrows Point, Md., and delivered to Socony in August.

Two Foster Wheeler water tube boilers provide steam at 850 F and 600 psi. A cross-compound Bethlehem turbine with double reduction gears will provide a normal shp of 13,600. Designed speed, loaded, is 16.5 knots.

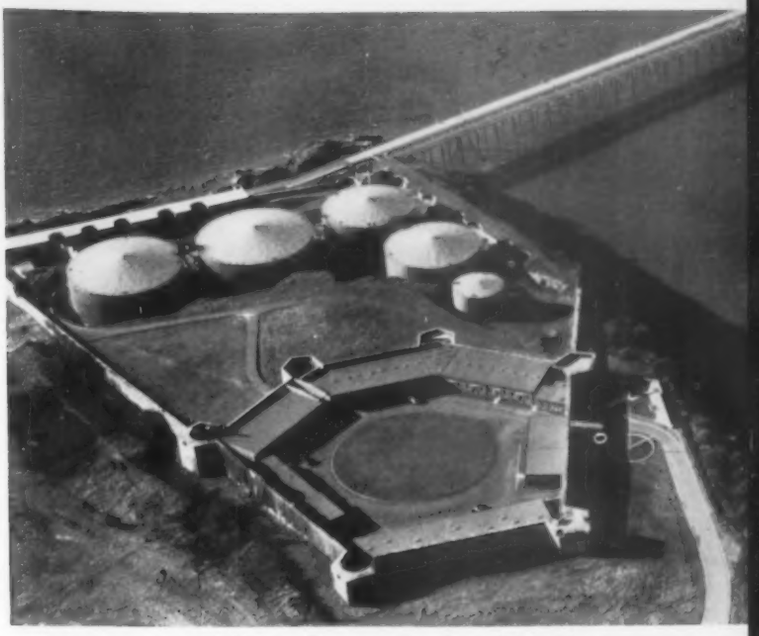
The first in a planned fleet of specialized carriers owned by Mitsui and Co. sailed in May from Tokyo to Houston. She was the 3,656 dwt chemical tanker, the "Santai Maru," built in the Osaka, Japan, yards of the Shioyama Dockyard Co., at a cost of 326 million Yen. She will be operated by Fuji Steamship Co. carrying petrochemicals from Houston to Japan. Mitsui is planning construction of further specialized tankers.

Other technological developments in the tanker field are discussed in separate articles elsewhere in this issue. END

New specialized tanker, Mitsui Bussan's 3,656 dwt "Santai Maru," will carry petrochemicals from Houston to Japan



Two 35,000-dwt tankers unloading crude oil are dwarfed by length of berthing head at British Petroleum's new Angle Bay ocean terminal in South Wales



Old Popton Fort was converted to administration offices for BP's Angle Bay terminal. Sea arm extends 1,200 ft from shore installation

New UK terminal at Angle Bay designed for 100,000-tonners

Angle Bay in Milford Haven—one of the finest and deepest natural harbors in the British Isles—has been used to advantage by British Petroleum's new ocean terminal, linked by a 62-mile, 18-inch buried crude oil pipeline with the company's Llandarcy, Wales, refinery.

The two-berth jetty at Popton Point is capable of receiving 100,000-ton tankers even at the lowest tide; its head lies on the edge of the deep-water channel, with 55 ft of water minimum. At the time of the formal opening by the Minister of Power in April, the first of the Group's new 50,000-tonners, the SS "British Queen," was unloading some 48,000 tons of Middle East crude. Swansea, the previous port of entry, can only handle relatively small tankers by today's standards.

As the pipeline can carry about 100,000 b/d, it is expected that the capacity of the Llandarcy refinery will be expanded beyond its present 60,000 b/d. Another factor is that next year the refinery will have to start meeting the feedstock requirements of the new petrochemical complex being erected at nearby Baglan Bay by British Hydrocarbon Chemicals and by Forth Chemicals.

Just above the new jetty at Angle Bay, the old Popton Fort has been restored skillfully and converted into a shore installation comprising offices as well as bunker oil and water tanker storage. The main crude storage tanks are 1½ miles inland. Built in 1863, the Fort was last fully garrisoned in 1904.

Sea Arm and Berthing Heads—The main problem for the jetty head was to design the best means of resisting the berthing force of a fully-laden 100,000-ton tanker. The most efficient design was for each berth to consist of a pair of solid mass-concrete strongpoints, each 74 by 38 ft and containing 4,500 cu yd of underwater concrete. These have been constructed inside steel sheet-piled cofferdams, driven down to the rock. This is known as a gravity structure.

The trunkway or sea arm from which the berthing heads are extended is 1,200 ft long and lies at right angles to the shore arm. The total length, including the dolphins at either side, is 2,300 ft. The flow boom installation at each berth is carried on a piled platform between the two strongpoints.

Tank Farm—Of the 220-acre tank farm site in another part of Angle Bay, some 56 acres are at present occupied by eight, 21,000-ton, welded steel, floating roof tanks.

Pipework linkup is so designed that any selected pair of tanks may be emptied or filled and the contents of any pair transferred to either or both of any other pair of tanks. A manifold comprising four 26-in. lines from each pair of tanks is located at the pumphouse; this manifold will be connected to the two 26-in. main transfer lines from the jetty.

The one main pumping station comprises four electrically driven 8 x 10 x 16 inch, single-stage, horizontal centrifugal pumps arranged in series. Each is designed with over 2,760 Imp. gpm capacity against 660-ft head at 850 psi pipeline working pressure. An automatic control valve at the pumping station prevents surges when stopping the pumps, and a control valve at Llandarcy maintains pressure at the highest point—672 ft—on the line.

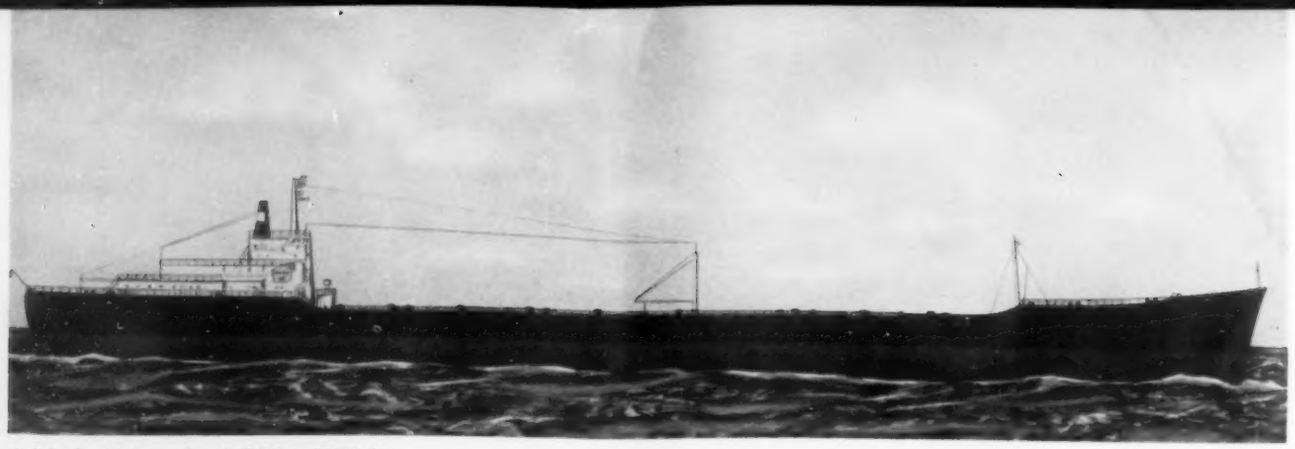
Pipeline—The 62 miles of 18-inch pipe supplied by South Durham Iron & Steel Co., consists of about 13,000 electrically-welded lengths, with each joint tested radiographically after welding and covering with glass fiber and bituminous enamel. Joints were finally tested under 100 psi air pressure and 1,200 psi hydraulic pressure.

The line is buried to a minimum depth of 2 ft 6 in. throughout, thus not interfering with normal agricultural work. Many obstacles had to be overcome in its laying, including 106 roads of various classes, one canal, 32 rivers or streams, three underground aqueducts, and several gas lines.

The entire terminal and the crude tankage has been fitted unobtrusively into the beautiful coast line under advice of Colwyn Foulkes, landscape consultant.

Main contractor for the marine work at the terminal was Christian & Nielsen Ltd. Consulting engineers were Rendel, Palmer & Tritton. Erection of all pipework, electrical installations on the jetties and approach arm, including stores derrick and hose handling gantries, and construction of all main pipelines and other services on the jetty were the responsibility of Constructors John Brown Ltd.

Other main contractors included: pipeline to Llandarcy—George Wimpey & Co. Ltd.; welding equipment—Lincoln Electric Co. Ltd.; pipeline pumps—Hayward Tyler & Co. Ltd.; and tank construction—Motherwell Bridge & Engineering Co. Ltd. The subcontractor for the gravity fenders was Weldall & Assembly Ltd. END



Artist's sketch of a tanker of 45,000 to 50,000 dwt, using bridge aft and planned by Sinclair

The case for the bridge aft tanker

LOCATING the navigation bridge aft rather than amidships on a tanker can provide substantial economic payoff—an estimated $863,000 for a 45,000 to 50,000 dwt American flag ship or $838,000 for a similar ship under a foreign flag, over a 20-year life.

This was brought out in a paper presented at the American Petroleum Institute's 1961 tanker conference by W. N. Damonte, vice president, and C. M. Lynch, marine department operations manager, Sinclair Refining Co.

Sinclair now operates two 25,000-dwt tankers with the bridge aft, prototypes in the field, which do not contain all the improvements possible with such a design. Based on studies of the performance and operation of both vessels, the company is so convinced of the advantages of bridge aft that their plans for future construction include a 45,000 to 50,000 dwt American Flag bridge aft vessel. It will be built at Bethlehem Steel's yard at Sparrows Point, Md.

The authors pointed out that the owners of the French "Altair," a 47,800-ton tanker, have been so completely satisfied with bridge aft that their plans for the future are reported to include even larger vessels with this design.

Four major economic benefits as well as improved personnel safety were cited in the case for the bridge aft tanker. The monetary gains were:

(1) Savings in original construction. Actual quotations obtained from a number of shipyards in the USA indicate initial construction savings cost on a 45,000 to 50,000-dwt U.S. Flag tanker with the bridge aft will be approximately $400,000. On a vessel of similar size built in a yard outside the USA, the savings will be about $250,000. This is predicated on the elimination of the midship house and service facilities that would be necessary, including the catwalk.

(2) Savings in maintenance, which are rather difficult to obtain precisely, were estimated conservatively at $200,000 on a U.S. flag vessel and $150,000 on a foreign flag ship during 20 years of operation by virtue of the elimination of the midship house, catwalk, etc.

(3) Increased freight earnings, because the vessel's light displacement tonnage will be reduced by 300 long tons through the removal of the midship house, service facilities, etc. Based on actual operating costs, Sinclair estimated that during an expected 20-year life, the owner should be able to realize additional revenue of $263,000 on an American flag vessel and $238,000 on a foreign ship.

(4) Reduced crew by automation. The authors feel the bridge aft tanker is the ideally designed craft to take advantage of the many new ideas in automation developed over recent years which have not been used on tankers. By centralizing all vital nerve centers on a vessel, it is conceivable that many mechanical devices could be employed, thus eliminating many ratings presently necessary for efficient operations. (Two innovations in this field are discussed later in this article).

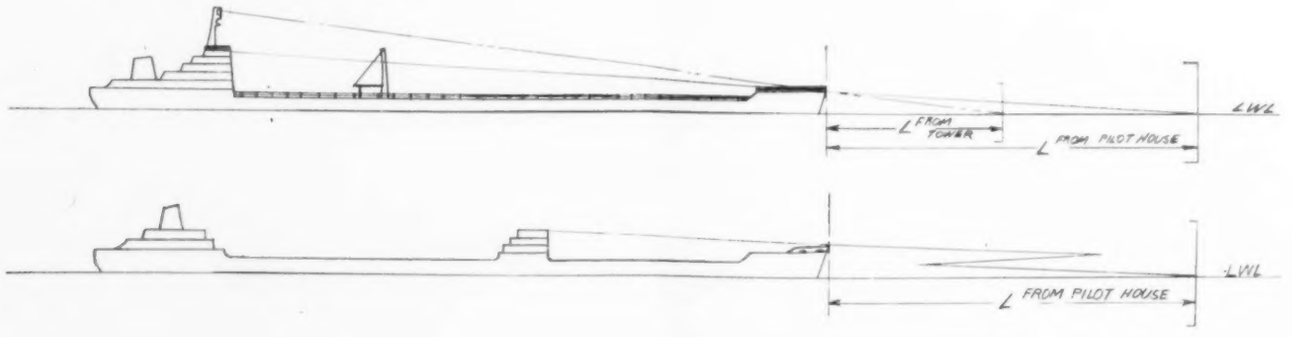
TABLE 1—How Bridge Aft Design Affects Angle of Visibility

(See also Fig. 1. L equals ship's length)

dwt of vessel	L.B.P. of vessel	Distance from bow to visible point at LWL
With bridge aft		
33,000	630	1.1 L (from pilot house)
33,000	630	0.5 L (from tower)
32,700	630	1.42 L (from pilot house)
32,700	630	0.58 L (from tower)
50,200	710	0.43 L (from pilot house)
50,200	710	0.25 L (from tower)
24,500	611	1.32 L (from pilot house)
With bridge amidships		
19,000	536	1.28 L
16,000	487	1.05 L
16,000	503	0.99 L
44,600	694	0.87 L
12,900	442	1.04 L
12,850	450	1.22 L
28,000	595	1.20 L
29,000	615	1.35 L
32,650	630	1.12 L

Several other improvements can be made in a large tanker with the bridge aft which would give still further safety and economic benefits, the Sinclair authors said. Among these: (1) location of all storage areas aft, (2) location of windlass under the forecastle head, (3) elimination of the bulwark on the forecastle head, (4) enlargement of the forward ballast compartments, (5) location of midship ballast compartments, (6) installation of large capacity ballast pumps for these two compartments, (7) in the future—lowered costs for installation of

Fig. 1—How the bridge aft design affects the angle of visibility. L equals the ship's length. See also Table 1



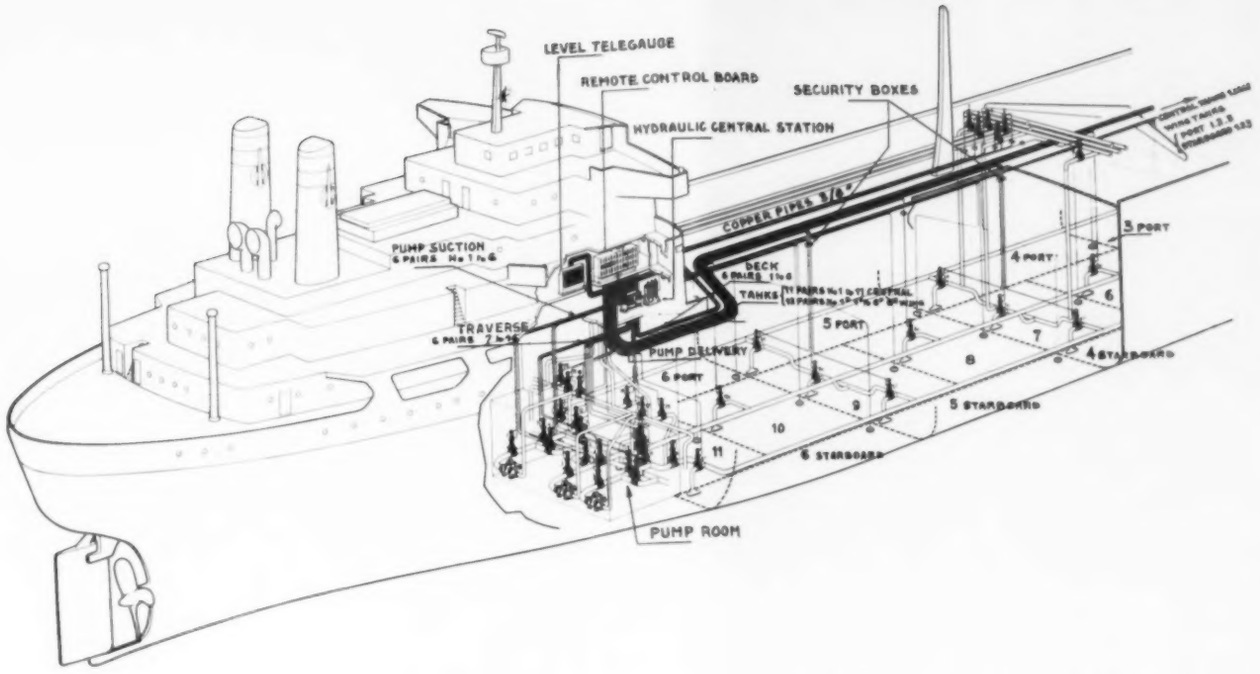


Fig. 2—Hydraulic remote control of cargo valves as installed on the 47,800-ton "Altair" class vessel of bridge aft design

such items as air conditioning, closed circuit television, remote cargo handling; and the elimination of pipelines utilizing large sluice valves, reduction in number of life boats, etc.

Possibly the greatest disadvantage to locating the bridge aft would be lack of experience of navigating personnel, according to Sinclair. The authors argued that there is a rebuttal to most of the objections raised by such persons.

Angle of visibility, for example, is perhaps the most controversial. This refers to the expected increase in the so-called "blind" area directly forward of the bow. This blind area is actually less on a properly designed bridge aft tanker than on a conventional vessel with bridge amidship. (See Fig. 1 and Table 1.) Proper design includes raising the height of the pilot house, utilizing and additional tower above the bridge if desired, and lowering the height of the forecastle bulwark.

Distance from center of rotation has also been suggested as a shortcoming. Sinclair says, however, that experience has proved there is no basis for this assertion. In fact, improved visibility of the vulnerable stern area tends to decrease accidents and damages to the propeller and rudder.

Loss of draft formerly experienced by having no midship house has been regained by increasing the sheer aft.

Among the more significant advantages given, especially in terms of the future, was the opportunity for increased automation. One example is the S.I.G.M.A. system of hydraulic and remote control of tanker cargo valves introduced by the MacGregor International Organization of London.

Reliability of this system has been proved out in some four years of operation in a number of tankers of Cie. Navale des Petroles of France. It was adopted on this shipowner's "Samarrah" in 1957, "Altair" in May, 1959, "Polaire" in December, 1959, "Rigel" in September, 1960, and is now being fitted into "Sirius" and "Vega."

Fig. 2 shows the installation on the 47,800-dwt "Altair," a bridge aft tanker. The equipment consists of a central hydraulic pumping and accumulator station, remote control panel, small bore piping, piston-operated cargo valves, and remote reading level indicators.

Each central hydraulic station comprises two 2-kw electric pumps (one for stand-by), and three oil-pneumatic accumulators in parallel. The pumps are stopped and started automatically by a pressure switch on the accumulator line. Hydraulic power from the pumps and accumulators is led to control valves on the control panel.

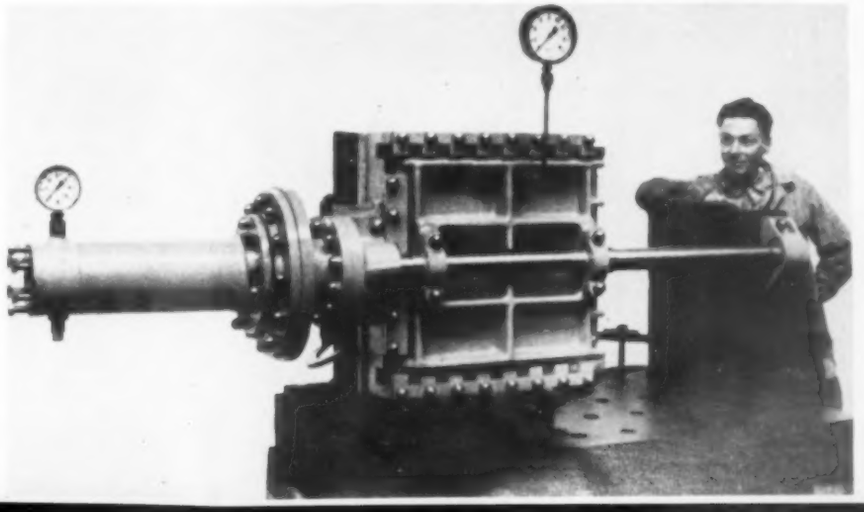
Each control valve operates a cargo valve and has three positions: open, closed, and neutral; the neutral position cuts the valve out of the system and allows stopping it in an intermediate position. Movement indicators show the condition of each cargo valve at any time.

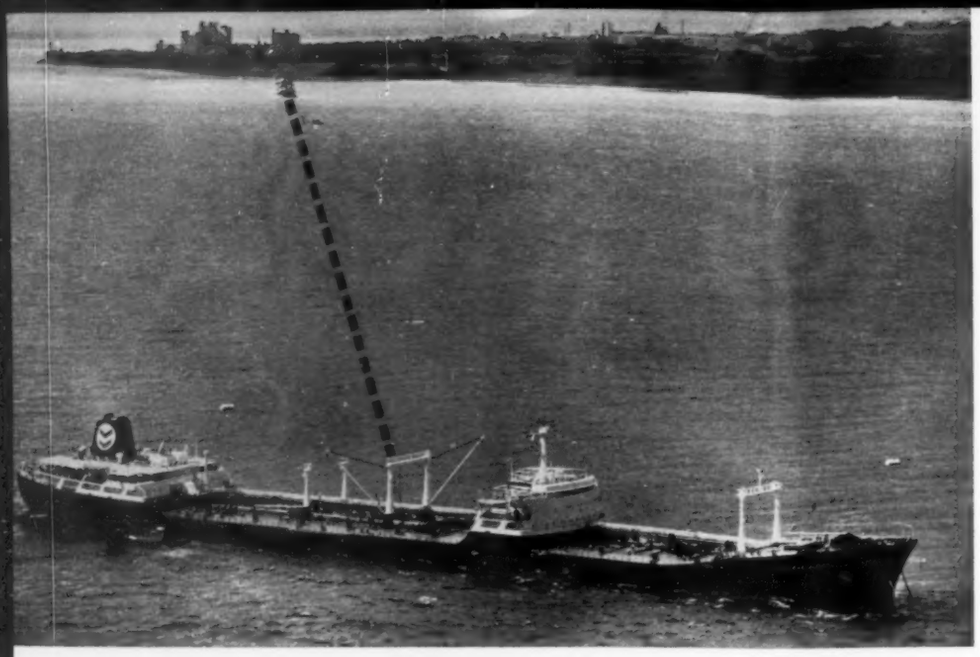
The lines between the control panel and the valves are of copper, $\frac{3}{8}$-inch internal diameter. In the unlikely event of a failure in these lines, emergency connections are provided on deck so that a portable hand-pump can be tied in to operate the valve.

The cast iron gate cargo valves are of the solid wedged, or double-disc type and are operated by a hydraulic piston which incorporates plastic material to ensure oil-tightness of the piston and glands at all times. The remote reading level indicators work on the principle of balancing air pressure against the head of the liquid in the tank. Level is read directly by mercury manometers, and the scale is adjusted for specific gravity between the limits of 0.65 and 1.04.

MacGregor has also introduced recently a new "free-flow" system of cargo handling which eliminates the need for large and costly cargo pipes, all of them subject to corrosion and all of them with diameters which necessarily limit the unloading capacity of the pumps. This new system provides for the installation of large, square gate valves in the bulkheads, very close to the ship's bottom plating. These are self-cleaning, and are hydraulically operated by remote control. END

The hydraulic piston-operated "free-flow" square gate valve.





The 41,800-dwt "George A. Davidson" at its mooring off Barbers Point at Oahu. The Standard of California refinery can be seen in the distant background. Underwater portion of pipeline to the mooring (see broken line) is more than two miles long

New sea terminal in Hawaii can handle tankers of all sizes

Unique design involves offshore tanker mooring, very long submarine lines, and a specially prepared sea bottom to assure proper anchorage in the hard coral

THE PROBLEM of designing marine terminals that can handle the large tankers of today can be, and is being, solved in a number of ways. One of these techniques—offshore mooring—has been in use for many years by a number of different industries. The increasing size of tankers has tended to make such moorings more attractive.

Among the more commonly used types of facilities to moor tankers in the open sea are: (1) submarine line sea terminals, (2) fixed berths, (3) hose-handling platforms, and (4) mono-moorings.

One major new sea terminal which presented all the usual problems, plus a few unusual ones not often encountered, is the submarine pipeline system and sea terminal of the new refinery of Standard Oil Co. of California at Barbers Point, Oahu, Hawaii. The project was described in a paper "Offshore Tanker Moorings," by Robert P. Howell of California Standard, and presented at the 1961 annual pipeline conference of the American Petroleum Institute in St. Louis, last spring.

As the principal supply facility for the 35,000 b/d refinery, the submarine pipe lines and terminal had to meet five important requirements:

(1) Moor the largest tankers now afloat —or contemplated—as well as the common T2 class of tankers.

(2) Receive a variety of crude oil from the East Indies, Saudi Arabia, Iran, and other sources. Some of these crudes are waxy, with high pour points. They must be heated for delivery through an underwater line, even at the water temperatures of Hawaii.

(3) Receive and ship heavy oils as fuel components or blending stocks. Some transfers with Standard of California's Pacific Coast refineries are expected.

(4) Occasionally receive and ship clean specialty products.

(5) Bunker tankers transporting crude to the refinery. The bunker fuels also require heating for efficient loading through a submarine line.

From a marine standpoint, a sea terminal in the Pacific Oceon off Barbers Point presented a number of unusual problems, first of which was the ocean bottom. It is smooth, solid coral and hard as rock—which it is of course.

Hopefully, Cal Standard's affiliate, California Shipping Co., made tests to see if a ship's anchor would hold, or at least "hang up" on coral heads. Tests were in vain. Dropped anchors dragging on the bottom would barely check the vessel's momentum from the weight of the anchor and chain. They could not be relied upon for help in maneuvering a ship into the moorings or to hold it in place.

The "heading" to be selected also gave the company some concern. The prevailing trade winds at this location blow *from* the shore, while the relatively small currents parallel the shoreline. Because of difficulty in getting into the moorings, it would not be feasible to use a heading with the vessel pointing out to sea.

And finally, there was the problem of the submarine pipe line. The underwater portion would be over two miles long and would go through the surf at an angle across a rocky shoreline.

Although the company suspected that the conventional sea terminal was the correct solution to the problem, they also looked at other possibilities. A sea island for berthing was out of the question because the cost of such a large structure in 65 to 70 ft of water in the open sea would be prohibitive. No possible saving in tanker time at the throughputs of the refinery would justify the expense.

Some type of small "island" structure to which the tankers could be moored by the bow seemed to be worth looking into. It would take care of the problem of anchoring on the coral bottom, and might have other advantages. Again, however, the cost of even such a smaller structure—plus the uncertainties over mooring and hose-handling problems with an unproved design—caused this possibility to be abandoned.

One further design possibility was the so-called mono-mooring. This is essentially a floating buoy, anchored to a given offshore location, and to which the vessel is tied at

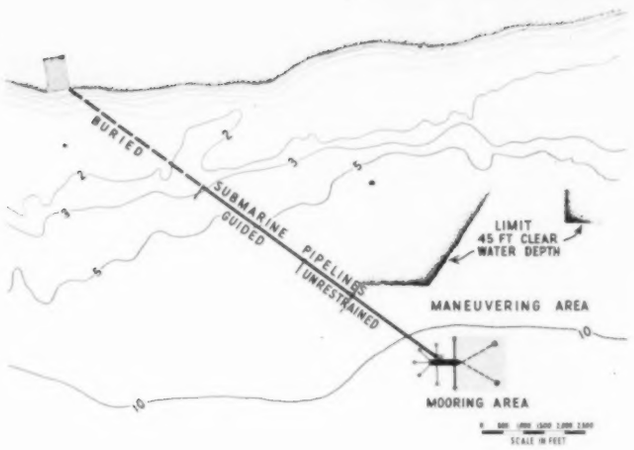


Fig. 1—Sea terminal area at Standard Oil of California's Hawaiian refinery

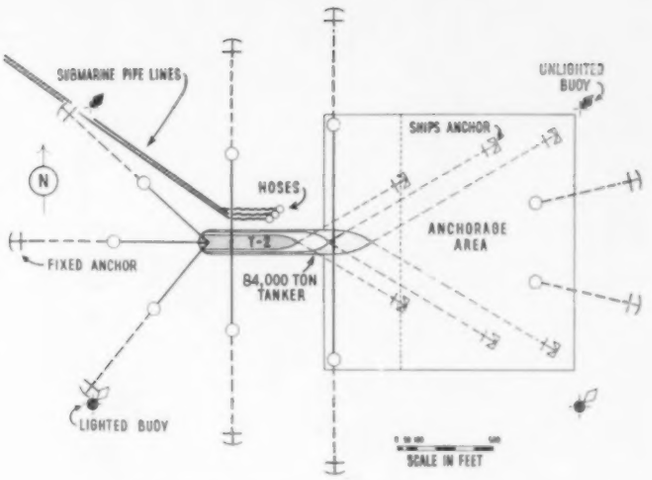


Fig. 2—Mooring arrangement at the anchorage area

the bow. Submarine lines run from shore, up from the bottom to the buoy, and thence are connected to the tanker via hose. The company regarded such a design as an answer to the anchoring problem to the variable headings desirable with the occasionally shifting winds. However, it too was abandoned as an approach because it seemed to be too great a step from the small mooring buoys previously designed. The company did not feel it could jeopardize operation with a device having so many untested features.

Thus the final decision, to utilize a conventional submarine line sea terminal, and then the problem of determining how to use it.

Moorings. Once the sea terminal had been decided upon, the company's marine groups asked that everything within reason be done to "rough up" the bottom so it would hold ship's anchors. Both giant rooters and explosives were considered. Explosives seemed most practical, and pilot tests showed that they would break up the coral.

The location of the terminal is shown in Fig. 1. Water at this location is 70 ft deep, both to give adequate depth for the largest tankers now foreseen and to provide an emergency maneuvering area between the moorings and shallow water inshore. The ship heading was selected parallel to the shore. It permits tankers to take the most common trade winds on the port bow quarter when in berth. It is also an acceptable position for the ship if she must leave the mooring in an emergency.

A seven-buoy mooring was used, as shown in Fig. 2. The arrangement of the buoys had to be such that tankers ranging in size from T2's to future 100,000 tonners could use the terminal.

The most spectacular part of the job was to prepare the bottom in the anchorage area. The final design chosen was a series of large trenches blasted in a "chevron" pattern (see Fig. 3). Trenches had to be wide enough so that flukes of the very largest anchors would not slide across without taking hold. They also had to be deep enough to let the anchors engage solid coral, with little chance of breaking off a "skin" of surface coral. The direction of the trenches was chosen to be approximately at right angles to the anchor chains of ships in the moorings.

The first step in trenching operations was to place cratering charges on 15-ft centers. These charges were 50-lb shots of 60% blasting gelatin. Two strings of cratering charges, each 650 ft long, were fired together. They produced craters about 6 ft in diameter, filled with pulverized coral. These initial craters were cleaned out with air lifts. Expansion charges of "Nitramon" were then placed in the clean craters and exploded. The result was a series of trenches made up of overlapping craters 15 ft or more in diameter. Rubble formed in the craters was left in place.

As soon as full trench had been excavated, California Shipping Co. brought in a tanker for an anchoring test. The anchor held firmly, and bottom preparation was then carried on to completion.

A total of nearly 230,000 lbs of explosives was used in the entire project. Most of the explosive was the Nitramon used in expanding the initial craters. Considerable quantities of the 60% blasting gelatin were used as expansion charges in areas of especially hard coral, in addition to being used for the initial craters.

Note in Fig. 2 that two permanent bow buoys were also provided at the edge of the prepared anchorage area. As a further safeguard to vessels in the moorings, lines can be run over the bow to these buoys in moderate or heavy weather when it would be unwise to depend absolutely on the holding power of ship's anchors in the coral trenches.

Submarine pipe lines. The crude line is a 30-inch line with a 6-inch internal heating line. Hot water in the internal line will be used for heating if a waxy crude should be left in the line, or if heating is needed for some other purpose. The hot water will be wasted to the sea. The internal line is also provided with a submarine hose and can be used for light products or clean refinery stocks.

The bunker line is a 20-inch line with a 4-inch internal heating line. For this system, hot water in the heating line will be used to preheat bunker fuel in the system and permit bunkering to start. Additional heat will not be required during normal bunkering operations. Again, the hot water will be wasted to the sea.

A feature of both systems is the careful attention given to design and fabrication of the internal heating lines. After installation, both internal lines were pretensioned cold to 17,000 psi to make sure they will remain in at least slight tension under usual operating conditions. With this pretensioning, the heating lines will have no tendency to expand—and perhaps buckle—as they might if neither stressed nor effectively guided.

For protection and weighting, both lines are Somastic coated and covered with a concrete jacket. The lines are also under cathodic protection for corrosion prevention.

No ballast facilities were provided. Most vessels using the terminal are large tankers coming in loaded. They take on salt water ballast for their return voyages. Other small vessels running to the Pacific Coast refineries will arrive with small amounts of ballast that will be kept on board. END

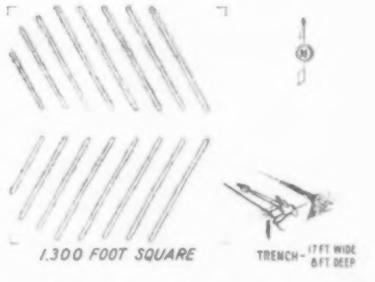
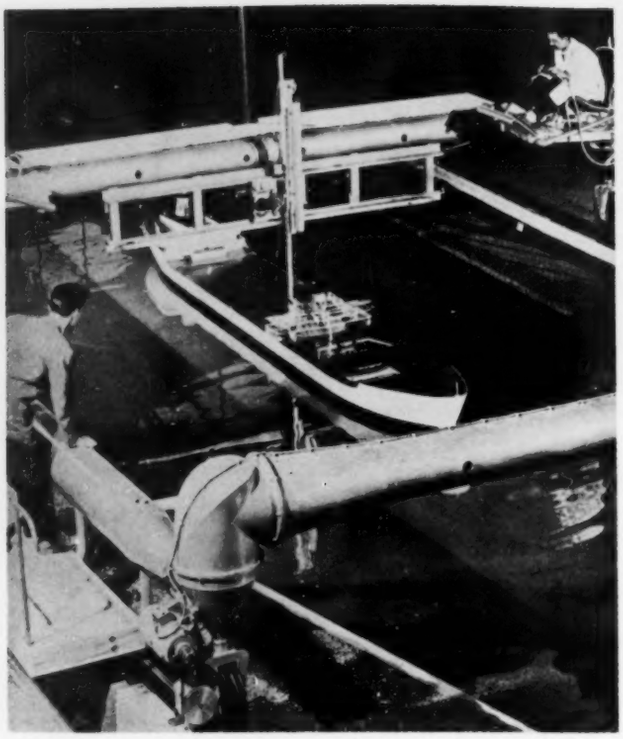
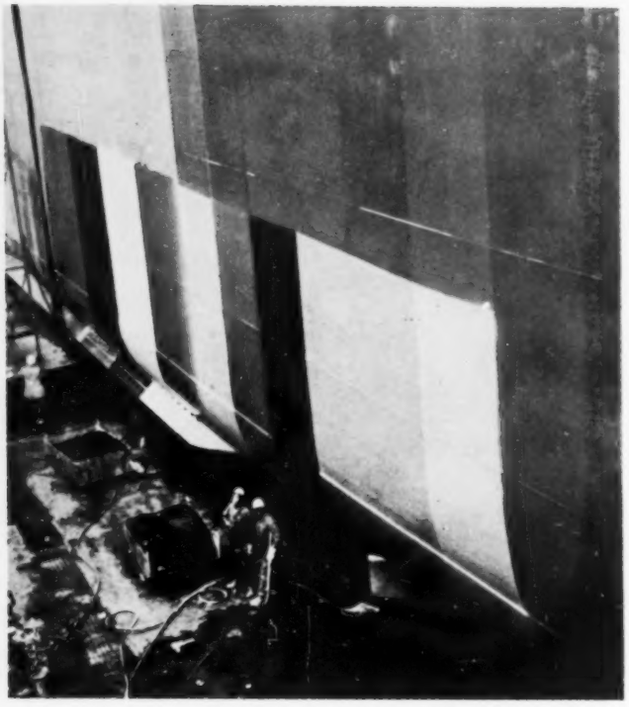


Fig. 3—Anchorage area detail. Trenches designed so that anchor lines cross them at right angles.



Suez Canal test, with "pilot" sitting in scale model of a 77,500 dwt tanker guiding it through miniature canal during tests at Grenoble, France



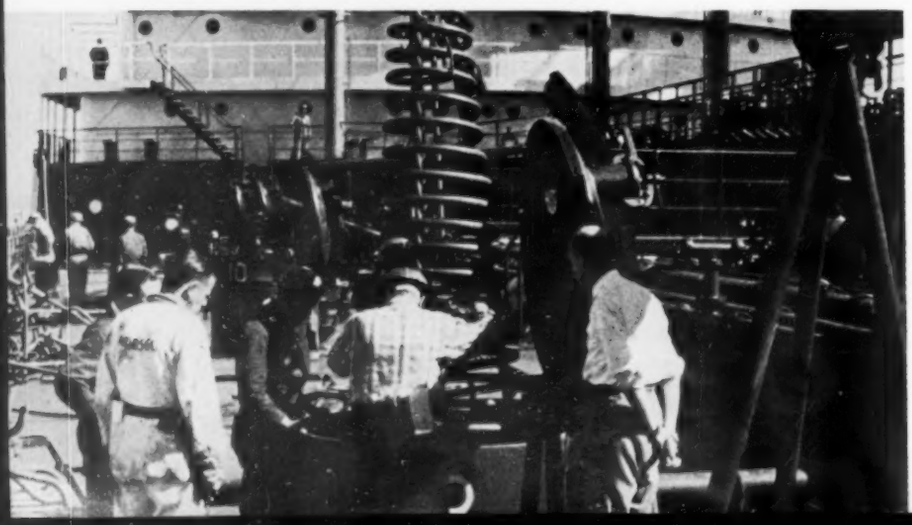
Humble Oil's "Esso Jamestown" in drydock after ten hull coating test strips were applied, part of project by Standard of Jersey and affiliates to improve tanker coatings

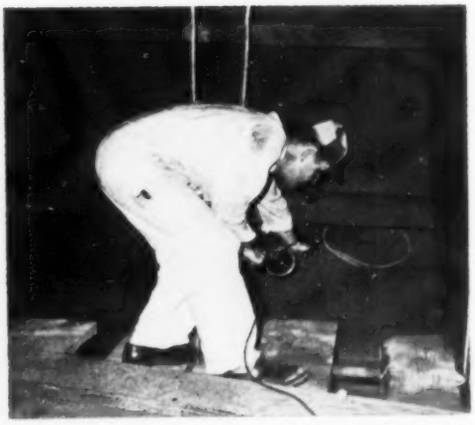
Jersey Standard conducts world-wide marine research

A WORLD-WIDE marine testing and improvement program being carried out by Standard Oil Co. (N. J.) through its central research affiliate, Esso Research and Engineering Co., is now in its third year of operation.

The program covers the oceangoing and inland waterways fleets of 20 Jersey Standard affiliates, representing a gross investment in marine equipment of over $800 million.

Two participants in Jersey's marine testing and improvement program—Esso Petroleum Ltd. and Esso Tankers, Inc.—are seeking ways to improve pumping rates for viscous cargoes. Here a new type of heating coil is lowered into a tanker as a part of the research program





Shipyard inspector checks a freshly-coated cargo tank for "holidays," areas missed during application of test coatings

So-called "spinning disc" tests conducted at Abingdon, England, laboratories of Esso Research Ltd. provide method of finding the most promising new hull coating formulations

Photo shows how a ship bottom looks after it has been in the water for eighteen months

Included in the program this year are 16 projects, one of the most interesting of which was the following:

A series of scale model tests are helping to determine how the 77,500-dwt tankers being built by several of Jersey's affiliates would handle in the Suez Canal. One such ship is the new "Esso Pembrokeshire," built for Esso Petroleum Co. Ltd., and launched late in June at Bremen.

The tests were made by a French marine research organization, SOGREAH, at its Grenoble model basin, where a section of the Suez is reproduced on a scale of 1/40, complete with scaled-down channel markers. A self-propelled 1/40 model of one of the 855-ft tankers was "piloted" through the canal model by a man sitting in the model (see photograph). Wind and water current were reproduced on the same 1/40 scale, and tests carried out to see how the ship would react to wind and current at various draft levels.

Scaling was all done so precisely that even the eyes of the operator, as he sat in the miniature tanker, were at the same level as would be the eyes of a pilot standing on the bridge of a full sized vessel.

Although the Suez has been greatly enlarged, it continues to be limiting in its allowance for supertankers. The depth of the canal allows a draft of only 35 ft. Its width is such that at the level of the ship bottom there is only some 60 ft between the hull and the sidewalls of the canal.

The proximity of the canal shores affects the stability of a vessel in motion. As the ship moves away from the canal axis it becomes subject to tensions imparted by the shore which is nearest. Generally, this tends to pull on the stern and start a lurch of the vessel to starboard.

The model therefore had to include a basin similar in design to the canal itself. The engineers selected the curve of the canal at its southern extremity, near where it empties into the Red Sea. At this bend, the tides run high and the currents strong. The wind also is strong enough to affect maneuvering.

The canal segment under a shed is about 600 ft long, and the model of the supertanker is 20 ft. The canal model is built of gravel so that the banks will not erode and the miniature vessel will not be damaged in the event of collision. A system of pumps makes it possible to vary the water level to simulate tides and produce current velocities either north or south. For wind, there are eleven fans.

The supertanker model is self-propelled, equipped with a battery powered electric motor and a propeller, the effect of which simulates that of a full scale screw propeller on the actual ship.

SOGREAH selected this type of piloting —with an operator on board the model— so as to further simulate actual conditions in every way. The operator has a steering wheel, and a bar to control the propeller speed. Ballast is distributed in the model so that the draft of the ship, its weight and moments of inertia are exactly what they will be in a full scale vessel.

The model is equipped with precision instruments which record the variations in six different factors of interest: (1) propeller rotary speed, (2) force absorbed by the propeller, (3) vessel speed with reference to the canal bank, (4) movements of the steering wheel imparted by the pilot, (5) the model's lateral deviations from the center of gravity with reference to the canal axis, and (6) angular deviations between ship axis and canal axis.

So that personnel can get the true picture, with the personal factor and influences of chance eliminated, each operator makes the passage from one end of the canal to the other several times.

Distance covered by the model must also be determined. To provide a means of reference, a large wagon, two wheels of which are in drive and which runs on rails laid along either side of the water level, follows the ship model's course. There are markers along the banks every eight feet, corresponding to an actual distance of 300 ft. Ship speed is recorded by the closure of an electric circuit each time the wagon passes a marker. There is no direct connection between the ship model and the wagon, so that the movement of the wagon will not affect the behavior of the tanker. Wagon motion is kept in line with the tanker by means of a sight glass and telescope arrangement.

Two other projects in the Jersey Standard program, being conducted jointly by Esso Research and several marine affiliates, are aimed at preventing corrosion on both the exterior surfaces and the cargo space of tankers. A rapid screening procedure was worked out for evaluating anti-corrosion coatings and the more promising coatings are now undergoing tests on the hulls of Humble Oil & Refining Co.'s "Esso Jamestown" and Esso Petroleum Ltd.'s "Esso Gettysburg" and "Esso Oxford."

The problem of static electricity is also being studied. A special device for measuring static electricity field strength in cargo tanks during loading operations has been designed as a tool for this work.

Esso Research's engineering groups are also conducting terminal design studies to evaluate the effects of wind and wave forces on moored ships, impact forces on berthing operations, fendering systems, and cargo hose handling arrangements.

Many of the affiliates who participate in the marine testing and improvement program do a portion of the actual research work, and all participate to the extent of providing details about operating and maintenance experience to those affiliates responsible for carrying out the work of the various projects.

The 20 participants in the program are as follows:

A/S Norske Esso; Creole Petroleum Corp.; Dansk Esso A/S; Esso Belgium; Esso Colombiana S.A.; Esso Nederland NV; Esso Petroleum Co. Ltd.; Esso Argentina; Esso Standard S.A.; Esso Standard S.A.F.

Also: Esso Tankschiff Reederei GmbH; Humble; Imperial Oil Ltd.; International Petroleum Co. Ltd.; "La Colombia" Soc. Marittina per Azioni; oy Esso AB; Panama Transport Co.; Standard Tankers (Bahamas) Co.; Stanvac; and Svenska Esso AB.

END

Typical right-of-way built up with riprap on frozen muskeg and clay for Alberta Trunk gas transmission line. Ditch cut without slopers for the 30-inch line

Winter no longer stops pipe line construction

Cleveland 320 and Buckeye 51 ditchers working in Pembina area. Frost line is only 12 to 18 inches deep. There is no caving.

Backhoe cutting through soft muskeg. Surface hard enough so Insley can walk without pads

PIPELINING IN WESTERN CANADA lost its seasonal disabilities last year, as construction work proceeded on a 12-month basis for the first time in history.

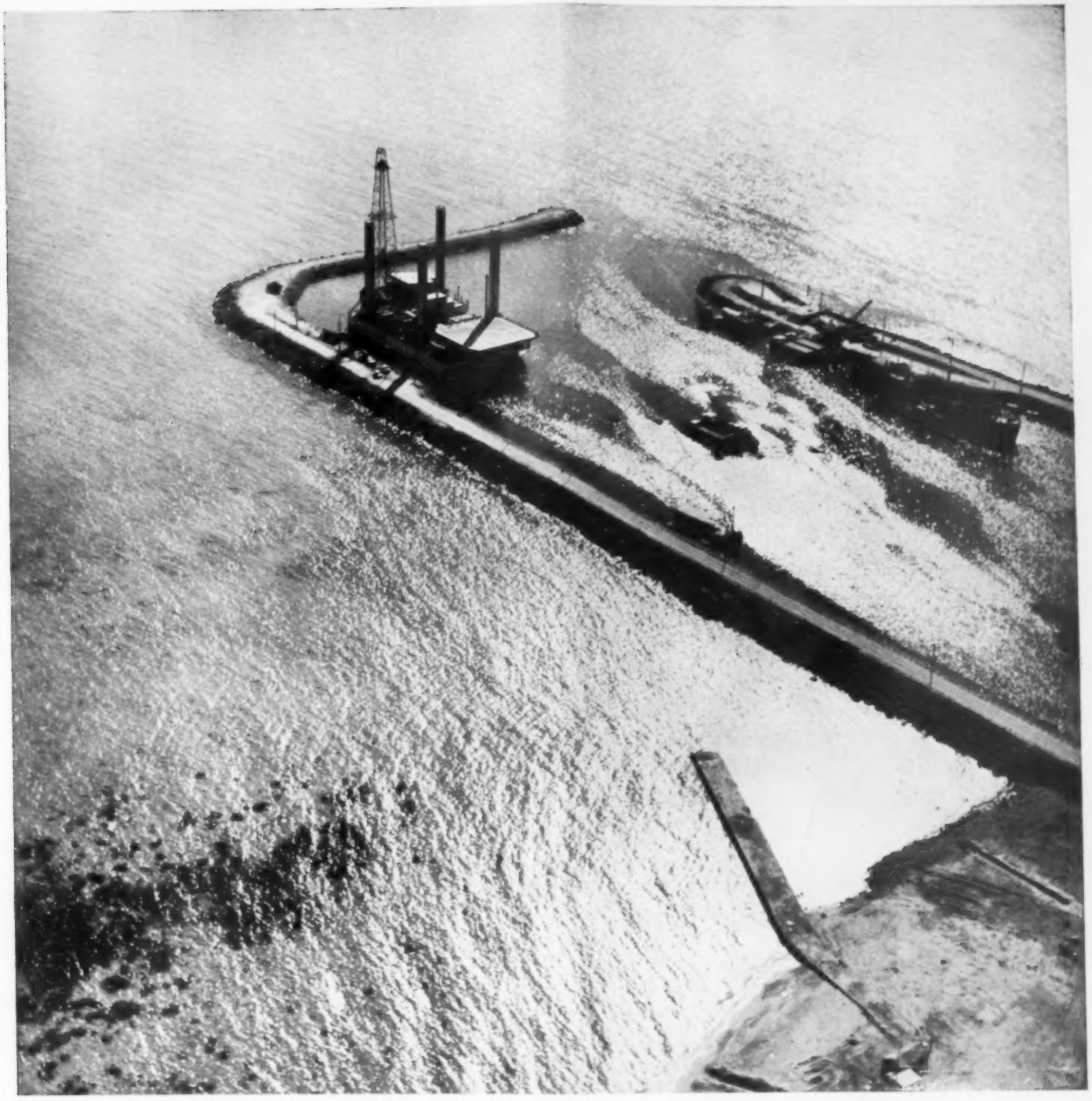
Stimulated by the necessity of getting the entire foothills division of The Alberta Gas Trunk Line Co. Ltd. into the ground by November 1, although the construction contracts were awarded only late last fall, contractors have hustled up new techniques, and have experimented with winter operations, to prove conclusively that seasonal interruptions for cold weather and even for wet periods can be practically eliminated.

Basic to this whole concept is adequate preparation of the right-of-way. Awarding contracts in the late fall or early winter permits clearing and grading of right-of-way when the ground is frozen and firm. This is vitally important where muskeg terrain is involved, because summer muskeg operations without winter preparation can bog down a pipe line spread so completely as to run away with all the profit margin on a job.

The methods used on the Alberta Trunk line last winter were developed over the past six years, along lines that proved successful in northern Alberta and northern Ontario, two of the most difficult muskeg regions in Canada.

The right-of-way is "riprapped" with timber cut by the clearing gang. This consists of laying logs across the right-of-way to a width of 20 ft or more, packing the spaces with clay, gravel or sand, and then building this up to a height of three to six ft above ground level. The packing, combined with the natural buoyancy of the timber, forms a floating mat which will withstand the impact of vehicles and equipment almost as well as any rural highway. It also forms an effective insulation which helps to keep the frozen muskeg from softening during summer pipelaying.

Power saws are used for cutting timber. Front-end loaders with open clamp arms carry and stack the logs, while bucket-type front-end loaders carry and dump filler material. The upper layer of muskeg, available right at hand, can be used to advantage for this. Once the grade reaches a suitable height, a finish surface of clay or gravel, depending on availability, is generally added for sealing, and smoothed with a patrol grader. Gravel, if obtainable without too



Shamals by Synoptics*...

THE SHAMAL WINDS – violently unpredictable – could spell sudden disaster for this mobile drilling platform in harbour at Das Island, in the brief, critical period of being moved at sea. But now the bogey of these ancient waters has been countered – by modern meteorology. *Adma Enterprise* with its drilling rig (owned and operated by BP in association with French interests) waits in berth till synoptic weather reports are assembled from the new network of weather stations in Iran, Kuwait and South-East Arabia. It will proceed only when the "all clear" is given. British Petroleum has taken a leading part in organising these Weather Reporting Stations. Thus drilling and pipe-laying operations, as well as shipping, now proceed more securely in these deceptive waters.

BP

* *"Synoptic meteorology is a weather-reporting technique based upon the collation and comparison of simultaneous reports from different areas."*

Stringing with 80-ft double-joint pipe handled with single-line sling

Sections ready for North Saskatchewan River crossing. High quality of right-of-way is shown in background hill

Automatic welding head ready to start outside pass for double jointing

Front-end fork lift loader handles three 30-inch pipe joints at one load

much expense, will provide an all-weather travelling surface, even in heavy rain.

Local labor can be hired easily for the right-of-way work. Contractors in the Alberta foothills, where the 1961 work is concentrated, have found Indians first-class workers on this part of the job. They are very efficient at cutting and packing the right-of-way grade.

The great advantage of early right-of-way completion is that pipe can be strung while the ground is completely frozen, with practically no damage to the travelling surface. Stringing trucks are the only units that have to travel in both directions on the right-of-way any substantial number of times, thus they can get all their work done before there is any risk of damage to the surface by chewing it up when the frost has come out.

Stringing on the Alberta Trunk job started in November and progressed with the right-of-way on all five spreads. The "boulevard" type right-of-way was good enough after the stringing that private cars or pickups could travel at 40 mph in most places. Stringing was completed before the spring breakup in all areas where there was terrain that could be damaged easily in spring or summer.

An unusually open winter, with very little snow and mild temperatures, was an unexpected asset in the program, but previous experience has shown that right-of-way and stringing can be carried on efficiently almost regardless of weather. In heavy snow the only additional work required is to bulldoze the snow from the right-of-way.

Double jointing of the 40-ft joints of 30-inch pipe was done on all spreads. Because of the extreme length of the 80-ft double joints, maximum load on stringing trucks was three joints at a time. In some areas additional flexibility was achieved by removing the poles from the trucks, so that the rear wheel assembly could be tied to the load near the back end. This was done particularly for uneven ground, where the overhang of the load on a normal tandem hookup would have exposed the pipe ends to the risk of being bumped on the ground when going over a dip.

Nearly all double jointing was done in a single Crose-Price-O-Matic mobile yard, which was bought by one contractor and subbed out to the others. This was the latest model of the highly automated design developed by H. C. Price & Co. and now manufactured by Crose-Perrault, Inc. Employing only 18 men, including the foreman, it was able to turn out as many as 157 welds in a relatively short day of about nine daylight hours in the middle of the northern winter.

Double jointing was by submerged-arc, using a fixed welding head mounted over a set of rollers and clamps which held the two joints firmly and rotated them under the head for two outside welds. Powdered iron flux moved in continuous flow as the entire welding operation was controlled by one man. A deeper inside weld was applied by a travelling boom operator who propelled himself inside the pipe at the next welding position and used a similar welding head riding on the inside of the pipe.

Moving at intervals of 20 to 25 miles, the yard could be dismantled, loaded for shipment, unloaded and set up at the new location in no more than 48 hours. Welding speed on the 30-inch pipe was 120 ft/min for the first pass and 95 fpm for the second pass. An interesting feature of this technique is that the welding ends of the pipe joints were mill-finished with no bevel, so that they fitted snugly against each other under the welding head. This ensured the deepest possible weld penetration. Propane flame-throwers were applied for 30 seconds to the incoming pipe for preheating during the cold weather.

Hydraulic controls were used for all pipe handling on the racks, between the delivery of incoming pipe from a big front-end loader to the pick-up of finished pipe by a Cat D7 sideboom tractor for movement to the stringing stockpipe.

Ditching in mid-winter also made a new record for western Canada. Because of a prolonged stretch of mild weather, and a frost penetration of only 12 to 18 inches in the ground, conventional rotary ditchers proved thoroughly practical and economical. Starting early in January, some contractors were able to get upwards of 1,400 ft/day with each machine, using Cleveland 320 and Buckeye 51 types.

The frost layer kept the ground firm for travelling, and ditch through clay or sand areas was cut without slopers, as the frost was just thick enough to remove any risk of caving. In muskeg, backhoes were used, an operation much more satisfactory than in summer. No mats were needed, because the backhoes could walk over the frozen surface. The only right-of-way preparation for both rotary and backhoe ditch was to bulldoze off the light layer of snow.

Muskeg areas contain a great deal of ground water, with the water table almost on the surface even in winter. Experience showed muskeg ditch to be least susceptible to caving if allowed to fill up with water: the water pressure is enough to hold the ditch sides in place. The muskeg ditch on the foothills line is expected to hold up well enough that a minimum of clamming out will be required when pipelaying starts this summer.

Most of the river crossings were put in during the winter, through the ice. A great deal of above-freezing temperature meant relatively thin ice. In most cases the contractors had to build up ice bridges for their access routes across the river ice. This was done by simply pumping water out of the river and running it through hoses along the route of the proposed bridge where it froze into an ice ridge which strengthened the natural river surface enough to carry heavy equipment. Sand and gravel, or clay and dirt, were spread as intermediate layers to provide some insulation against melting of the bridge in warm weather. END

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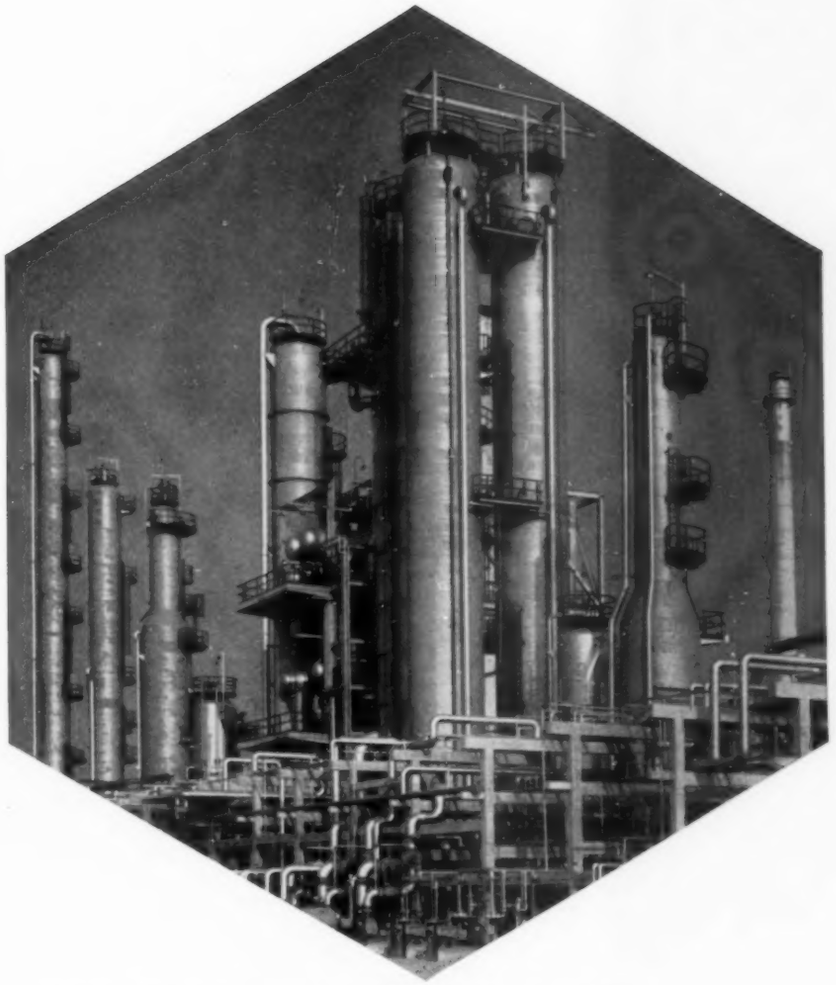

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Tanker corrosion prevention progress

Continued good service and payout is reported in the use of various coatings, particularly inorganic zinc types, as well as in the use of cathodic protection on ballast tanks

NEW DATA on methods of fighting corrosion on tankers indicate successful progress is continuing. Results of work by oil companies as well as the U.S. government in the use of coatings and cathodic protection were reported at the 1961 annual tanker conference of the American Petroleum Institute.

A comprehensive study of coating materials by the Military Sea Transportation Service has convinced that group that coatings provide the only known fully effective barrier to cargo tank corrosion. Thus far, coating applications have been limited to tankers already in service. However, based on the experience to date, the MSTS feels strongly that corrosion protection should be incorporated as early as possible in the life of a ship. Consequently, when and if appropriations for replacement MSTS tankers are approved, it is intended to incorporate coatings as part of original construction. Meanwhile, all new methods of corrosion protection will continue to be investigated for possible use on MSTS ships.

The MSTS program began in 1954 when 21 ships of the T2 and AOG types were coated with Saran. Fifteen of these are still in active service. In addition, two T5's were coated last year, one with Dimetcote #3 and the other with Devran. Another T5, the USNA YUKON, has been coated with 17 experimental coatings for exposure under actual service conditions and to determine the safest and most economical coatings suitable for MSTS service.

Many benefits from the use of the Saran have been intangible and not easily measured in dollars and cents, the MSTS said. They were nevertheless real and indisputable, and provided heavy evidence in support of this method of corrosion control for the service's ships:

(1) Reduction of safety hazards by taking less than half the original time for gas freeing.

(2) Elimination of mucking and scale removal, thus releasing the ship's force for other shipboard maintenance.

(3) Increase in cargo flexibility by being able to change from black to clean products more readily in the event of an emergency cargo requirement. In several T2's, this has actually been accomplished by machine washing at temperatures no higher than 150 F, and flushing of tanks and pipe lines with about 600 bbl of solvents.

(4) Reduction in repairs to pipes, valves, and pumping systems. Cargo pumps in coated T2's are nearly all original equipment and still in good condition.

(5) Less contamination.

(6) Reduction in turnaround time due to ease of inspection, locating fractures, etc.

Touch-up costs have also been extremely low. The original study that led to use of the coatings had an estimate for touch-up of 5% per year of original application cost. Actual touch-up costs, including recoating in way of damage, tank fractures and pipe repairs have averaged less than 2%. And, because tank and pipe repairs make up about half if not more, it is apparent that touch-up for coating failures only have been less than 1%. Therefore no touch-ups between annual inspections are needed.

A variety of surface preparation methods have been used at option of the repair yards —power wirebrushing, grinding, or blasting. Large surface areas have been touched up by spraying, but small scattered areas have been recoated by brush.

The test program on the YUKON involving some 17 different materials was undertaken because of some of the extra hazards inherent to Saran applications. While it was regarded as an excellent material and possible of safe application under properly controlled conditions, the MSTS was seeking less expensive coatings and methods which could give the same degree of corrosion protection and quality control.

As a result of this work, the Commander, Military Sea Transportation Service (COMSTS) has approved Dimetcote #3 and Devran 3 for addition to the MSTS coating bidding list, which up to May, 1959 included only Saran. A fourth coating, Rust Ban 190, is about to be added. Approval has been purposely made stringent by insisting on 18 months of satisfactory performance in service without any special instructions to the crew.

Some new materials were tried on the YUKON in December 1960 as a result of increased interest in the field of inorganic zincs. No data has been accumulated as yet on the new coatings; inspection for performance is scheduled for December.

Saran is a vinylidene resin; Devran 3 is an epoxy resin; and Dimetcote #3 and Rust Ban 190 are inorganic zincs. Among the other coating materials tested on the YUKON have been polythiokol, coal tar epoxy, polyurethane resin, modified phenolic, and phenolic epoxy type formulations. The products carried in the YUKON cargo tanks have included aviation and motor gasolines, jet fuel, and diesel fuels.

The most significant value of zinc-rich silicate coatings on cargo tanks is their helping to maintain product quality, according to another API paper, by R. P. Orgonas and B. R. Strickland of Esso Research and Engineering Co.

By minimizing rust scale and pitting, these coatings essentially eliminate possibility of product contamination, the Esso men reported. They permit easier and more thorough cleaning of compartments when changing from one product service to another, and they minimize the pickup into the product of rust particles which cause contamination as well as erosion of pumps and valves during unloading operation.

These advantages are attainable primarily in the handling of clean neutral products. Zinc coatings, on the other hand, are not suitable for aqueous or organic materials which are significantly acidic or alkaline. This could include certain crude oils, refinery wastes, and unfinished product streams which might contain carry-over from chemical processing operations.

Refinery waste would be an unusual kind of material to handle in a tanker. However, one method of disposal of wastes such as spent caustic and sour water is to carry them out to sea in a tanker and dump them well away from land.

The problem with less refined products and some process gas oils is that they may contain enough natural acids to cause zinc pick-up. The amount of zinc picked up will depend upon conditions of contact and the zinc level which can be tolerated will vary with the type of product. Therefore, the use of zinc coatings must depend on a careful consideration of all factors involved.

It was pointed out by the Esso Research technologists that oils containing appreciable organic acidity will also attack uncoated steel. For example, acidic process gas oils used as cat cracking feed stocks will pick up iron soaps, which poison cracking catalyst activity. This would be in addition to any iron carried as suspended iron oxide. Available data indicate iron to be a worse catalyst poison than zinc.

The study also showed zinc coatings to be the most versatile for solvent transport service. While the epoxy resins and the polyurethane resins as well as zinc coatings are satisfactory for the aliphatics, such as paint thinners, dry-cleaning solvents and the like; it has been found that the aromatics will attack all but the zinc-rich silicates.

(*Continued on page 70*)

Originated by Cities Service, this 24,000-pound capacity truck speeds delivery of grease to industrial plants

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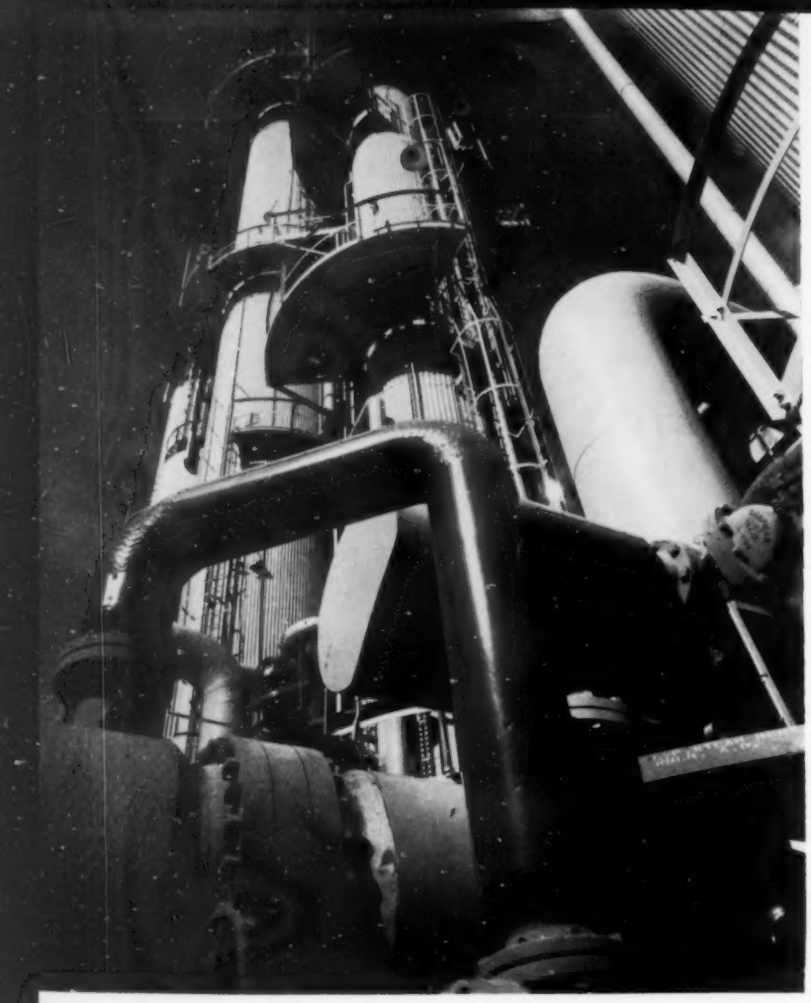

Udex unit, used for recovering toluene from catalytic reformate. Photo courtesy Delhi-Taylor Oil Corp.

New technology boosts markets for petrochemical toluene

by Peter W. Sherwood*

TOLUENE, a glut on the market in early 1959, suddenly threatens to be in short supply in some locations until plants under construction can catch up with new demand.

This sudden change must be ascribed to new toluene-consuming chemical technology which began to make itself felt in late 1960. Biggest single factor is the introduction of hydrodealkylation of toluene to benzene. This process was first commercialized in late 1960 (by South Hampton Co.) and is expected to provide plant capacity of 97 million gal/yr by early 1962.

Other recent technological developments contribute to the starring role which toluene will soon assume as petrochemical raw material. Among the more important: a new route to phenol, a novel commercial synthesis for caprolactam, new toluene-based methods of terephthalic acid, and rapid growth in demand for tolylene isocyanate.

In all of these areas, consumption for toluene is expected to grow rapidly. Alongside, there will continue to be the slower-growing (or declining) uses on which the present toluene market is founded: high-octane blending stock for gasolines, use as solvent, production of trinitrotoluene, vinyl toluene, chlorinated, sulfonated and nitrile derivatives. All told, the market for toluene is estimated at 255 million gals. in 1960, is expected to reach 345 million gals. by 1965.

Two sources supply these requirements. In late 1960, installed USA plant capacity for toluene production was 360 million gal/yr. Of this total 315 million gal/yr was provided by recovery from aromatic petroleum stocks. The balance is derived from light oils formed in coal coking operation; thus its possible realization is tied to the level of steel production—expected to be between 50 and 60% of capacity during 1961.

Not only greater outlet volume but also a higher product price are the incentive for moving toluene into the chemical market. Internal refinery economics determine the value of toluene used as high-octane stock, typically in the range 13-16¢/gal. The value, in general, has been under pressure for several years as the demand for aviation gasoline has declined and adequate means are at hand to provide needed octane levels with or without toluene.

At the opposite end of the scale, chemical-grade toluene prices are firming up following their earlier decline from 32-34¢ throughout most of the 1950's to 25¢ in 1958. First sign of firming prices in chemical (nitration-grade) toluene is a rise from 25¢/gal, delivered, to 25¢/gal, fob, freight equalized, which took effect at the beginning of 1961.

Long-range, however, there will be no shortage in toluene supply. One recent estimate suggests that about 3.5 billion gal/yr toluene are potentially available from refinery streams; additional facilities for recovery of this hydrocarbon can be readily installed. This will continue to justify the production of benzene from toluene which is about to move into high gear.

Key is the intrinsically lower availability of virgin benzene in petroleum stocks and its significantly higher demand, chiefly for chemical consumption. (USA total benzene consumption in 1960 exceeded 500 million gals.) Thus, benzene is currently priced some 9¢/gal above toluene (though the spread has been as little as four cents in 1955). Even at a lesser differential than that now existing, a good payout can be obtained on hydrodealkylation plants.

Less clear, except for local conditions, is the switch of phenol production from benzene base to toluene. This is not expected to become a major move. When Dow's toluene-based phenol plant comes on stream (probably in mid-1962), this route will account for only 36 million lb/yr phenol out of a total USA installed capacity of 980 million lbs.

Process economics of this phenol process must be viewed in comparison to the conventional methods of synthesis—cumene hydroperoxide, chlorination-caustic hydrolysis, oxychlorination-steam hydrolysis (Raschig), and sulfonation. Actually, the

*Chemical Engineer, White Plains, N. Y.

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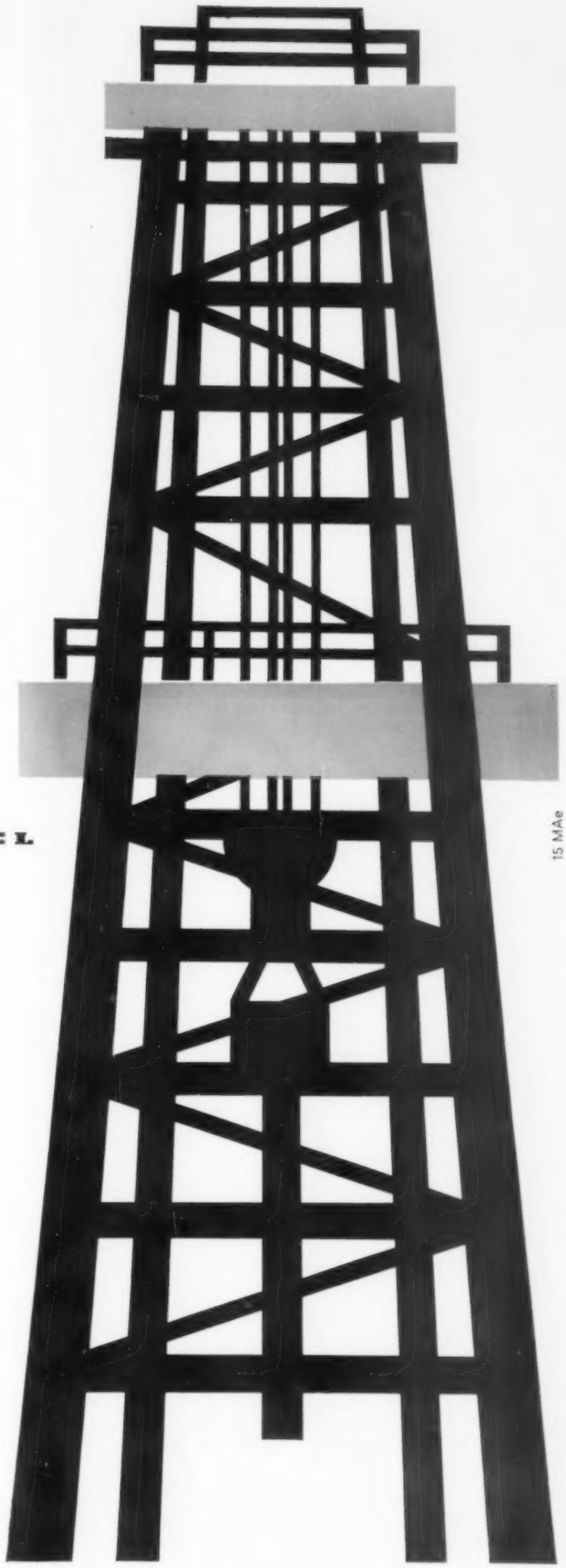

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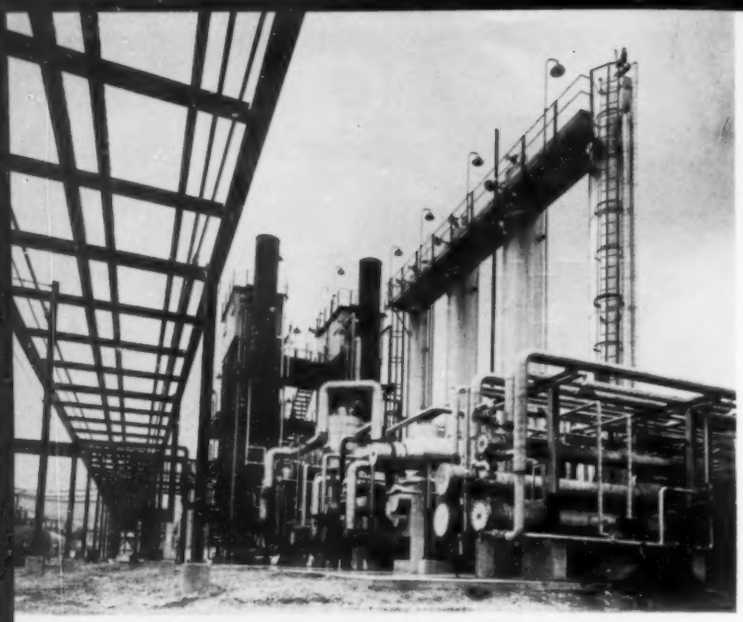

Facilities for production of toluene diisocyanate, an intermediate in production of urethane plastics and resins. Photo courtesy of National Aniline Division, Allied Chemical Co.

differential in hydrocarbon cost, about which much has been written, is far from being the controlling factor. More importance attaches to ability to dispose of by-products formed in the various routes (none in the toluene route at balance, or in the Raschig process) and to integration of the plant with facilities for production of other needed raw materials. A particularly interesting possibility of the toluene conversion to phenol is the ability to utilize intermediate benzoic acid for other processes as well, thus spread cost of manufacturing this toluene oxidation product for a reduced unit price.

Toluene as raw material for caprolactam is a totally new development. A process employing this route has been developed by Italy's Snia Viscosa is reportedly the basis for a plant now being built by Allied Chemical Co., currently one of the two largest factors in caprolactam production. Need for caprolactam is tied primarily to fast-growing nylon-6, offers good promise for further increase in toluene demand.

Very good promise is seen in the use of toluene for tolylene isocyanate production. This intermediate's importance rests in manufacture of polyurethane resins which rose from 40 million lbs. in 1958 to 90 million lbs. in 1960, are expected to reach at least 325 million lbs. by 1965.

Two other large chemical consumers of toluene exist, but their outlook for future sales appears to be regressive. Need for trinitro-toluene (TNT) is overshadowed by more effective explosives, toluene consumption for its manufacture is expected to drop from the present 8 million lb/yr to 6 million lbs. by 1965. Similarly, little if any future expansion is seen in detergent-grade toluene sulfonates, which currently consume some 3-4 million gal/yr toluene.

Alongside these primary chemical consumers, other chemical outlets for toluene dim in importance: vinyl toluene—small and not growing, benzonitrile, benzaldehyde, chlorinated toluenes, etc. Potential interest attaches to benzoic acid (aside from its new role as intermediate in phenol and caprolactam synthesis) as a raw material in the terephthalic acid process of Henkel GmbH. Two other terephthalic acid processes, based on toluene, are known to have been investigated in pilot-plant work, and these will be discussed briefly below. However, none of these methods for TPA production from toluene appear to be headed for early commercialization on a substantial scale.

Thus, fuel use is the present large consumer of toluene, and chemical consumption is the big market for the future. The third category, intermediate in unit value of toluene as well as in *present* volume, is use as solvent. Total use of toluene in this function is estimated at 30 million gals., may reach 35 million gals. by 1965. This market exists, above all in the production of paint and related products, but includes also such diverse applications as production of rubber cement, thinning of vinyl organosols, etc. Use of toluene as solvent in surface coatings is, however, under competitive pressure from other hydrocarbons—especially xylenes—and from the expanding acceptance of water-based paint formulations.

Thus, among the three main market grades for toluene, a marked change in distribution is expected. One recent forecast [1] depicts the trend as follows (in million gal/yr):

	1955	1960	1965
Gasoline	124	128	100
Solvent	20	30	35
Chemical	30	37	171
USA Consumption	174	195	206

It is evident that future growth of the toluene market is controlled entirely by developments in the chemical field. As we have pointed out in our discussion of market trends, the upcoming chemical outlets have been created entirely by new technology: hydrodealkylation, conversion to benzoic acids and its derivatives (notably phenol and caprolactam), production of tolylene isocyanate, and of miscellaneous minor derivatives. It is with this new technology that the remainder of the present discussion will be concerned.

Hydrodealkylation to Benzene: Aromatic hydrocarbons can be freed quite readily of side chains which contain two or more carbons. More drastic conditions are called for in the removal of methyl groups; i.e., in the dealkylation of toluene.

In any event, dealkylation must be carried out in the presence of an acceptor for the free alkyl radical. In reactions which are of commercial interest or potential, this acceptor may be either another aromatic ring (disproportionation) or hydrogen (hydrocracking or hydrodealkylation).

Either of these basic reactions may be carried out in a variety of ways. For example, in disproportionation an exchange may be effected between two molecules of toluene or between one molecule each of toluene and naphthalene, etc. In any event, an equilibrium is established between the various forms of methyl donor and acceptor. For example, if the feed contains only toluene, the calculated equilibrium mixture at 80.6 C contains 30.0 mole-% benzene, 44.0% toluene, 24.0% xylenes plus some higher alkylated benzenes.[19] Unconverted toluene must be separated and recycled. Such disproportionation reactions are catalyzed by aluminum chloride, aluminum bromide, alumina-silica, and related (Friedel-Crafts) catalysts.

The alternative route of dealkylation—hydrocracking—may be carried out under cracking conditions in the presence of hydrogen under pressure or in the presence of liquid hydrogen donor such as tetralin. Both methods are carried out in the temperature range 450-650 C and over a wide pressure range. While the use of liquid hydrogen donors has the advantage of avoiding the fairly costly compression of hydrogen to high pressure, its economics have fallen short of commercial acceptability because the donor itself takes up a large portion of reactor space and because it must be rehydrogenated in an ancillary operation.

Thus, for benzene production from toluene, commercial interest has been directed principally to "hydrocracking" in the presence of gaseous hydrogen, a method currently referred to as "hydrodealkylation."

Hydrodealkylation may be carried out thermally or catalytically. Bethea [16] finds that effective thermal dealkylation of toluene may be effected at temperatures between 650 and 705 c and pressures of 200-600 psig with 5000 SCF hydrogen per bbl. of feed. Only very little degradation occurs, and benzene yield ranges from 91-95 mole-% at per-pass toluene conversions between 72-25%.

Numerous catalysts have been proposed for the hydrodealkylation of toluene. Among the more interesting catalysts, mention may be made of alkali-promoted ferric oxide or chromium oxide, nickel or cobalt on various carriers, alumina-supported NiO-Cr_2O_3, ferric chloride, chromia-alumina, and molybdena-alumina.

Doumani [17] has investigated the effect of various catalysts (platinum, cobalt oxide, molybdena, promoted molybdic acid) on hydrodealkylation of toluene, reports best

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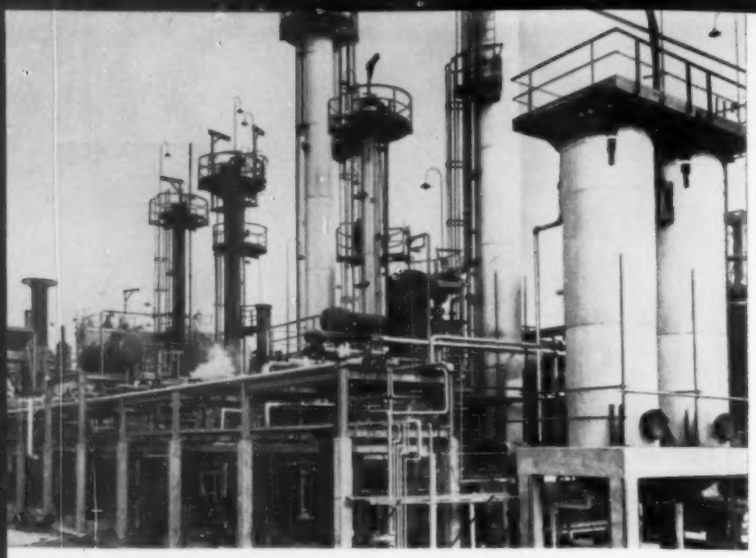

One of the first Hydeal process units for converting toluene to benzene by a new process — hydrodealkylation —is this unit at Signal Oil & Gas Co. completed late in 1960. Photo courtesy of Universal Oil Products Co.

performance with catalysts containing molybdic acid. In the absence of steam, a substantial amount of toluene was converted to methane ($C_6H_5CH_3 + 10H_2 \rightarrow 7CH_4$) but this reaction could be entirely suppressed by introducing about 2 moles steam per mole toluene (the amount of steam needed for best yield increases with hydrogen:hydrocarbon ratio and with total operating pressure). This addition of steam serves the further purpose of minimizing catalyst fouling reactions.

Increasing pressure has a beneficial effect on conversion. By increasing pressure from 250 to 1000 psi, Doumani raised benzene yield in toluene hydroalkylation from 83 to 97%.

Coonradt [18] reports use of chromia on alumina as catalyst for toluene dealkylation. Using a coprecipated chromia-alumina bead catalyst containing about 32 wt-% Cr_2O_3, and operating at 595 C, liquid hourly space velocity of 0.24, and in the presence of 2.7 moles hydrogen per mole toluene feed at a pressure of 800 psig, he obtained a reactor product containing 61.7 wt-% benzene, 21.6% toluene and 9.6% gas. This corresponds to an ultimate benzene yield of approximately 94% of theory.

Benzoic Acid and its new Derivatives: As of early 1961, benzoic acid still belongs to the class of specialty chemicals. Principal use is in the manufacture of specialty plasticizers (benzoates), in the food industry as preservative, and in the synthesis of a number of benzoyl compounds.

Benzoic acid has long been produced by nitric acid oxidation of toluene but it is now also available as by-product of certain liquid-phase air oxidation processes, notably those practiced for conversion of ethyl benzene to acetophenone and methyl phenyl carbinol (Union Carbide), conversion of xylenes, to phthalic acids (Amoco), and conversion of cumene to cumene hydroperoxide as intermediate in one phenol synthesis (Allied Chemical, Hercules Powder, Monsanto Chemical, Shell Chemical, Standard Oil/California/). It should be noted that not all of these potential producers are set up to recover and refine by-product benzoic acid.

The impending large-scale need for benzoic acid is impelled by the development of new processes for the production of phenol, caprolactam, and terephthalic acid, in which benzoic acid figures as intermediate. At present, only two USA plants are involved—Dow's 36 million lb/yr phenol plant now under construction at Kalma, Washington, to which we have referred above, and the new caprolactam facilities of Allied Chemical in which Snia Viscosa's new, toluene-based route is to be employed. In addition, the benzoic acid route to phenol will serve at plants now under construction at Tilbury Island, B. C. (Dow Chemical of Canada) and at Rotterdam, Holland (by a joint subsidiary of Staatsmijnen in Limburg and Dow Chemie A. G.).

Basis for production of benzoic acid on the contemplated large scale is the oxidation of toluene. The conversion may involve air, SO_2 or sulfur as oxidizing agent. When air (or oxygen) serves in this function, either vapor or liquid-phase techniques may be employed. Present technology leans toward air oxidation of toluene in the liquid phase; other methods of toluene conversion will be considered here only briefly for purposes of comparison.

Use of sulfur as oxidizing agent takes its cue from the related conversion of *m*- and *p*-xylene to isophthalic and terephthalic acid, respectively, which is practiced commercially by Oronite Chemical Co. The method calls for operation at high water:toluene ratio (in excess of 20:1), at temperatures between 260 and 370 C and pressures correspondingly high enough (order of 1300-3000 psig) to maintain a liquid phase. In related processes, ammonia is introduced with the feed. Toland [2] indicates benzoic acid yield of approximately 75% in this oxidation of toluene by sulfur.

Use of sulfur dioxide as oxidizing agent for toluene is described by Strickland.[3] The reaction, carried out in the vapor phase at atmospheric pressure calls for oxides of vanadium or tungsten as preferred catalyst. Typical operating conditions are 350-365 C, contact time of 3-5 seconds, 4.5:1 mole ratio of toluene to sulfur dioxide. Strickland claims a benzoic acid yield up to 75% on sulfur dioxide, realizes per-pass conversion of only 28%.

Air oxidation of toluene in the vapor phase may be directed toward benzoic acid formation by catalytic use of hydrogen bromide. Rust [5] uses toluene and oxygen in approximately equal volumes, adds HBr at the rate of 0.5 moles per mole hydrocarbon. Operation is at about 200 C and atmospheric pressure. Benzoic acid is reported at 91.3% of oxygen consumed (note that theoretical oxygen requirement is 1.5 moles per mole toluene). A controlling problem in the process is recovery of relatively expensive HBr, some of which is consumed in side reactions.

Several processes have been described for liquid-phase air oxidation. The preferred catalysts are either oil-soluble manganese salts or more particularly, oil-soluble cobalt salts.

In these methods, only partial conversion is taken per pass, and by-products are formed which will slow down and even stop further progress of the main reaction. Taplin [6] points out the importance of minimizing formation of such by-products, and of removing from the recycle such deleterious material as may be formed by caustic extraction of the water-washed toluene effluent from the converter.

Brill [7, 8] describes catalytic use of cobalt salts promoted by some of the lower ketones. The reaction is carried out in acetic acid containing a small amount (but greater than 0.5 molar) water. Recommended concentration of toluene is between 0.5 and 2 moles per liter. With each mole toluene, between 0.05 and 0.12 cobalt acetate and 0.2-0.3 moles methyl ethyl ketone is introduced. Oxygen is used as oxidizing agent (oxygen purity must be at least 85%) and operating temperature is between 70 and 90 C. Benzoic acid yield is reported to be as high as 89% on toluene in single-pass conversion.

Benzoic Acid Conversions: As mentioned above, *phenol* production is to be an initial major consumer for benzoic acid. The process [9, 10, 11] involves air oxidation of two moles benzoic acid to form phenyl benzoate which is hydrolized to phenol plus benzoic acid.

The oxidation is carried out in the liquid phase and in the presence of soluble cupric salt which may be promoted by some magnesium salt. Biphenyl, toluene, or benzene are the reaction medium. Temperature is about 230 C. Hydrolysis to phenol is effected by steam injection, either directly into the oxidation stage or into a separate reactor. Phenol yield on benzoic acid is reported to be 80-83%.

Use of benzoate salts to produce *terephthalic acid* constitutes a (presently noncommercial) version of the Henkel process, which has the objective of avoiding the high raw materials cost of p-xylene, which is the feed material in present TPA synthesis. The method involves conversion of

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potassium benzoate to potassium terephthalate and benzene.

Details of the process have been reported by the author elsewhere.[12] The reaction is carried out at 350-450 C in the presence of catalyst (cadmium iodide), water acceptor (aluminum carbide), acid acceptor (potassium carbonate) and carbon dioxide pressure between 100 and 400 atmospheres. At these conditions, the reaction mix is in the solid phase, and ball mills or similar equipment must serve as converters. TPA yield in the range of 80-90% has been reported.

Production of *caprolactam* from toluene is the subject of a recent process developed by Italy's Snia Viscosa and licensed in the United States by Allied Chemical Corp. which is now building a plant based on this method. The substantial need for product caprolactam stems principally from rapid expansion in demand for nylon-6, a caprolactam derivative.

The process[21] involves the reaction of nitrosyl sulfuric acid with a substituted cyclohexane. Two toluene derivatives are possible candidates: methyl cyclohexane and hexyhydro benzoic acid. While the former is by far the lower-cost raw material, caprolactam yield obtainable from methyl cyclohexane is less than 30% of theory, and this does not appear to be the commercially interesting approach.

Of substantially greater interest is the reaction of nitrosyl sulfate with hexahydro benzoic acid, itself a hydrogenation product of benzoic acid. Nitrosyl sulfuric acid employed in the conversion is obtained by a simple exothermic addition reaction of sulfur dioxide with fuming nitric acid.

Benzoic acid may be hydrogenated to hexahydro benzoic acid in the presence of a number of standard catalysts, among them platinum oxide, palladium oxide, platinum black, palladium black, or Raney nickel. For example, Kindle[22] obtained nearly quantitative yield of hexahydro benzoic acid by reacting benzoic acid with hydrogen in alcohol solution and in the presence of palladium black at room temperature. Of crucial importance is the complete absence of chlorine compounds from the system in order to suppress formation of esters.

Conversion of hexahydro benzoic acid to caprolactam by action of nitrosyl sulfuric acid is carried out in the presence of concentrated sulfuric acid or oleum. Best results are reported at a ratio of nitrosyl sulfuric acid to hexahydro benzoic acid which is slightly in excess of unity. Total amount of sulfuric acid (including the quantity in the nitrosylation agent) is 2.5 moles per mole organic feed material.

In one example illustrating operating conditions, 36.5 g nitrosyl sulfuric acid, 23.5 g 100% sulfuric acid and 47.2 g 23% oleum are reacted at 100 C for one hour. After cooling the mixture, 44 g hexahydro benzoic acid is introduced gradually and the batch temperature is held at 55-60 C. Addition of the organic material takes place in the course of somewhat over one hour. After addition is complete, the reaction mass is gradually heated, in the course of 2.6 hours, to 60-65 C, at which time evolution of by-product carbon dioxide had ceased, indicating completion of reaction. After purification, per-pass conversion of hexahydro benzoic acid in this conversion is found to be 61%; ultimate yield of caprolactam is reported at 90% of theory.

Toluene Diisocyanate: The importance of toluene diisocyanate stems from the compound's use as a raw material in rapidly growing urethane resins. The USA market for polyurethane foams (main consumer of urethanes) rose from 35 million lbs. in 1958 to 100 million lbs. in 1960, and is expected to reach 200 million lbs. by 1963, 300 million lbs. in 1965. Average consumption of isocyanates is about 33 lbs. per 100 lbs. polyurethane resin.

Several isocyanates are employed in this function but toluene-derived toluene diisocyanate is definitely the most important. Isocyanate production capacity has been expanded rapidly to meet the growing market requirements. Projects under construction will raise isocyanate facilities in the USA from 60 million lb/yr in late 1960 to approximately 105 million lb/yr by the end of 1961. Biggest factors in this business are Mobay Chemical Co. and DuPont, with Allied Chemical in third place. Minor production (one million lb/yr) is also available from Carwin Co., and several other companies are known to be contemplating entry into the field.

Toluene diisocyanate is produced from toluene by the series of reactions (below).

The first two steps in the synthesis sequence, Equation (1), employ long-established technology which need not be considered in this place. The interested reader is referred to standard works dealing with nitration and amination by reduction (e.g. 13). It is important merely to note that the chiefly-desired 2, 4-toluene diamine is not formed exclusively but that it is accompanied by its isomer 2, 6-toluene diamine which may be converted, in the subsequent steps, to the corresponding diisocyanate.

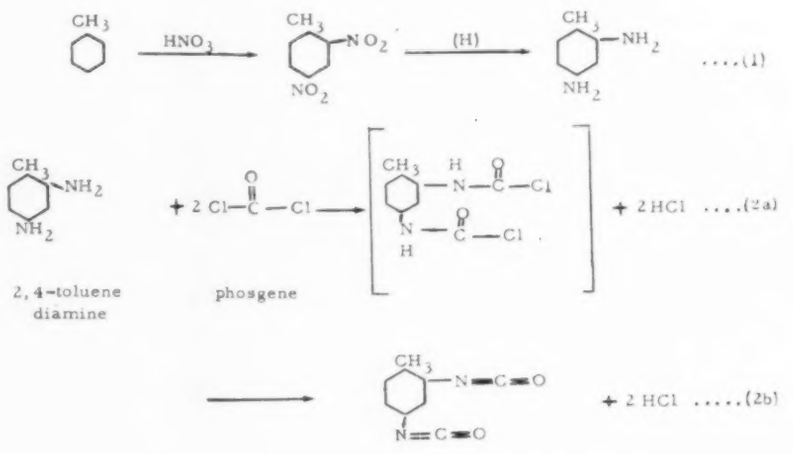
In a look at the new technology, special interest attaches to the reaction series depicted in Equations (2a) and (2b). This sequence is usually carried out in two steps, essentially as shown, though both reactions proceed to some extent in each stage. Accordingly, phosgene is fed to both stages. The crucial difference between the two reaction steps is the operating temperature which should be low (< 60 C) in the phosgenation and high (100-200 C) in the final conversion to the isocyanate. The entire conversion is carried out in the presence of an inert solvent.

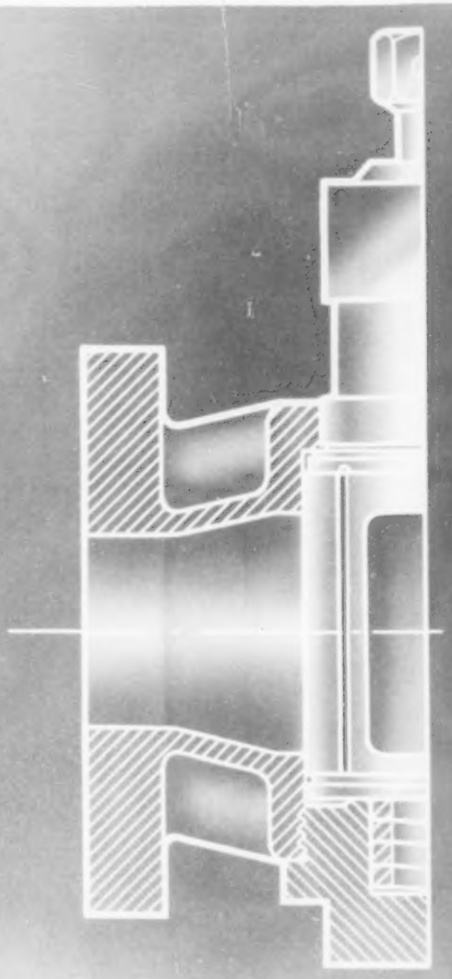
A significant contribution, due to Farbenfabriken Bayer,[14] has been the use of highly efficient rotary mixing equipment (> 1000 rpm) for execution of the first reaction step. Use of such equipment reportedly permits very short contact time and thus makes it unnecessary to cool the highly exothermic reaction system.

In one series of tests, feed stock was a mixture of 70-80%, 2, 4-toluene diamine and 20-30% 2, 6-toluene diamine, dissolved in ortho-dichlorobenzene. This was intimately mixed, without external heating, with an equal volume of a 50% solution of phosgene in o-dichlorobenzene in a centrifugal pump operated above 1000 rpm. The reaction mixture was then heated to 140 C while introducing phosgene until a clear solution was obtained. Yield of toluene diisocyanate is reported at 85%, based on the starting amine.

First step in purifying the isocyanate is to strip any excess phosgene and HCl which remain in solution. Next, the solvent is distilled off. This is followed by overhead removal of the diisocyanate. In due course, the solution is reduced to a distillation heel of viscous tarry matter containing some 40-50% toluene diisocyanate. It is impractical to reduce the concentration of the compound below this level because the tarry residue is very viscous and difficult to handle, and because it will decompose

(*Continued on page 68*)





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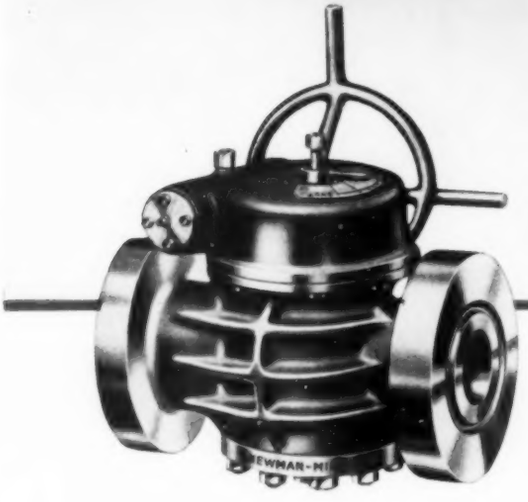

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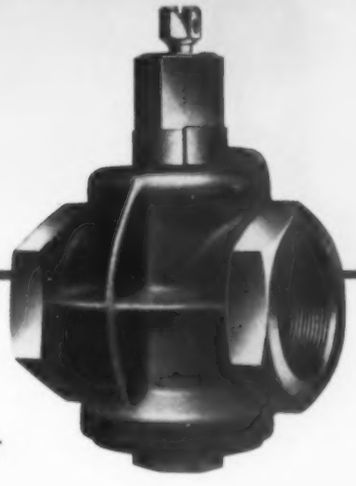

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by William C. Uhl
Processing Editor

Highlights of the month—heavy fuel oil has promising market as blast furnace fuel, although natural gas and powdered coal may provide strong competition. Are lower octane motor fuels staging a comeback? Another new approach to the problem of atmospheric pollution

A new use for heavy fuel oil—as a blast furnace fuel—is moving rapidly toward commercial scale reality as a result of a successful test program in Hamilton, Ontario, during the past year.

Called hydrocarbon injection, the new technique was first reported in this column late last year (WORLD PETROLEUM, December, 1960, p. 80). It utilizes the fuel oil to provide a part of the heat and combustion gases required to reduce iron ore (oxide) to iron in the furnace.

The experimental program at Hamilton has been conducted by Dominion Foundries & Steel Ltd., Imperial Oil Ltd., and Esso Research and Engineering Co. on a new blast furnace Dofasco built with a capacity of 1,200 to 1,300 ton/day of pig iron. Oil is injected through 14 specially designed nozzles, one in each of the hot air blow pipes leading into the bottom of the furnace.

Advantages to the method are very attractive to steel makers:

(1) Coke requirements are substantially reduced. Standard Oil (N.J.) and its affiliates who have been working on the project estimate one barrel of fuel oil will replace about 600 lb of coke.

(2) Furnace output is greatly increased, since there is additional space in a given furnace for more ore and limestone.

(3) Closer control of furnace operating conditions is made possible through direct control of fuel flow through the injection nozzles.

(4) An installation is relatively inexpensive, about 0.5% of the cost of an average new furnace, or in the range of $100,000.

(5) Payoff is very good. Jersey Standard technologists have estimated that in some cases hydrocarbon injection will save up to $1 million per year per furnace.

Savings will vary greatly around the world, depending upon relative costs of coal, oil, and gas in different locations and on the equipment for individual furnaces. Heavy fuel oil will apparently offer the greatest economy in most countries. However, in the USA, natural gas injection can be expected to be more widely used. Humble Oil & Refining Co. is already selling gas commercially to two steelmakers in Texas.

Experimental work with both oil and gas has been going on at a number of steel mills in Europe and North America besides the Hamilton project.

The potential market as a new use for oil is very large. For the free world, SONJ estimates it might reach, by 1970, as much as 100 million barrels per year of oil and more than 200 billion cubic feet of gas annually.

Considerable interest has been shown in the Hamilton experiment by steel men throughout the world. Jersey Standard said that during the past year, blast furnace experts from England, Germany, France, Sweden, Belgium, Chile, Argentina, Australia, India, and Japan, as well as from the USA and Canada, have visited the Hamilton operations, the Esso Research Center in Linden, N. J., and a pilot operation at Bruceton, Penna. The latter was the site of a project which preceded the Hamilton experiment; Esso Research teamed up with the U.S. Bureau of Mines and the United States Steel Corp. in work at the Bureau's 20 ton/day experimental blast furnace at Bruceton.

A very recent report indicates that an Egyptian steel company will use the Jersey Standard system in its blast furnaces. Based on furnace capacities in this case of 800 ton/day, fuel oil consumption has been estimated at about 550 b/d, and will give an annual coke saving of about $2 million.

It should be pointed out that the coal industry has not been standing still during this work. Blast furnace coke is coal's second largest market, and the steel industry through various economy steps has already reduced its use of coke per ton of iron by some 15 to 16% in the past decade.

Late in August it was reported that powdered, low volatility coal could also replace coke successfully as a blast furnace fuel, as a result of experiments by National Steel Corp. at the Buffalo, N. Y., plant of its subsidiary Hanna Furnace Corp. Bethlehem Steel Co. was also a participant.

Hanna said it has been successful in reducing the coke requirements in a blast furnace by about 20%, and expects to be able to raise this to some 30% by further work currently under way. Coal costs run between $4 and $10 per ton compared with $15 to $20 for coke. The powdered coal is fluidized by air and injected through furnace lances inserted into the furnace tuyeres.

Lower octanes in the offing once more? Lower octane gasolines (as much as three points below most regular grades) have been undergoing test marketing by Gulf Oil Corp. and Sun Oil Co. Both companies are reported to have stated that these new fuels reflect the growing popularity of the compact automobiles, which can operate satisfactorily on a lower grade gasoline.

True, the new fuels may also have been designed to meet the growing competition from "off-brand" gasoline which frequently sells below the price of the "branded" fuel. However, some oil companies expect to meet this type of competition by cutting the price of their regular grade rather than by lowering octanes.

Growth in the compact cars sales, however, has definitely continued, and at even higher rates than the earlier predictions had indicated. As of July 31 of this year, the USA-built compacts alone accounted for 34.5% of total cars produced. During 1960, they represented just under 25% of all sales.

Another new tool has been made available to the petroleum processing industry in its fight against atmospheric pollution. A technique for plants with sulfide odor problems, it utilizes catalytic oxidation and removes odors by actual chemical reaction.

The technique has been used to kill hydrogen sulfide, methyl mercaptan, and other alkyl mercaptans in stack gases from an oil refinery and from a paper mill. It uses a material developed by Rhodia, Inc., called "Alaxol SRM," and said to be a mixture of organic and inorganic compounds, the identity of which were not revealed. When it is added to stack gases, it speeds up the oxidation of reduced sulfur compounds either in the stack or in the open atmosphere immediately surrounding the stack top.

In the refinery installation, at Great Northern Oil Co., St. Paul, Minn., the material is mixed with water and fed through a proportioning pump to the base of a 100 ft stack which takes coker drum blowdown. Control is manual, the flow being determined by the operator. At the paper mill, Champion Paper and Fiber Co. in North Carolina, the material is sprayed into the base of a stack from the recovery section as well as into the gases flowing from the digestor blowdown. Control is automatic. In both cases, plant officials are satisfied with results.

The material costs about 90¢ per lb, and each lb will destroy about 50 lb of sulfides and disulfides. No comparisons have been made with other types of odor control on the basis of cost; however, catalytic oxidation does one job other methods do not do. It promotes a chemical reaction which *destroys* a given noxious odor. One existing technique, the use of a masking agent, involves simply a strong perfume (sassafras, wintergreen, pine, or others) which "covers" or dominates the unwanted odor. Generally, this is not used for industrial odor control.

The other method involves counter agents, which will neutralize the odor in a physical mixture, but do not kill the material causing it. Hence, an odor which has been neutralized by a counter agent merely returns once the counter agent is removed. Neutralizing without actual destruction would be hazardous in the case of such sulfur materials as hydrogen sulfide. It would seem, therefore, that this new technique will be interesting to a good many refiners.

What's New in Processing Plants

Contract awarded—for the multi-million dollar expansion of Soc. Industrielle Belge des Petroles's Antwerp, Belgium, refinery, to Foster Wheeler Corp.'s French subsidiary Soc. Foster Wheeler Francaise. Scheduled for completion by spring of 1963, the project includes a 100,000 b/d crude still with LPG recovery facilities; a 10,000 b/d Shell Trickle desulfurization unit; an 11,500 b/d UOP Unifiner-Platformer; and hydrogen sulfide absorption and sulfur recovery unit having a capacity of 60 long ton/day.

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Process units planned at the new $4.5 million refinery now being built by Canadian Kodiak Refineries Ltd. at The Pas, Manitoba, include catalytic cracking, desulfurizing and TEL blending. Crude still start-up is planned for December; cracking unit and asphalt facilities are expected to be completed by May, 1962.

• • •

Under construction—the $17 million, 20,000 b/d refinery at Port Dickson near Kuala Lumpur, Malaya, by Standard-Vacuum Oil Co., first refinery in that country and Stanvac's first on the mainland of southeast Asia. Start-up is expected early in 1964.
Process units will include atmospheric and vacuum distillation, platinum type catalytic reforming, catalytic desulfurization for Diesel fuels, and an asphalt plant.

• • •

Planned—a $3 million 16,000 b/d expansion in crude capacity of its 94,000 b/d Sarnia, Ontario, refinery, by Imperial Oil Ltd., for completion early spring of 1962. Contract for a large part of the project has been awarded to Canadian Bechtel Ltd.

• • •

Planned—a $125 million 100,000 b/d refinery, by Standard Oil Co. of Kentucky, at Bayou Casotte,

(*Continued on page 66*)

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(*Continued from page 64*)

near Pascagoula, Miss. Project is contingent on approval, by the stockholders of both companies, of the proposed merger of Kentucky Standard with Standard of California, which already has U.S. Justice Dept. blessing.

• • •

Shut down—Anglo American Exploration Ltd.'s 4,000 b/d refinery at Hartell, Alberta.

• • •

Site selected—by Indian Refineries Ltd. (government company) for its 2-million ton/yr Gujarat State refinery, at Koyali, a village 10 miles from Baroda. Two thousand acres of land have been acquired.

• • •

Partial shutdown planned—by Kerr-McGee Oil Industries, at its 23,000 b/d Cushing, Okla., refinery. Obsolete gasoline and fuel oil facilities will be shut down. Modern lube oil units, including propane deasphalting and phenol treating, will continue in operation.

• • •

Contract awarded—by Empresa Colombiana de Petroleos to M. W. Kellogg, for expansion and modernization of its Barrancabermeja, Colombia, refinery, for completion in the fall of 1962. Project will include a 9,150 b/d vacuum still, phenol extraction, deisopentanizer, and a stabilizer.

• • •

Completed—a 2,700 b/d Unifiner-Platformer and a 5,000 b/d middle distillate Unifiner, at Consumers Cooperative Refineries Ltd.'s Regina, Sask., refinery.

• • •

Completion date set—for new 40,000 b/d Ingolstadt, Germany, refinery of Deutsche Shell, to be January, 1964.

• • •

Location changed—the new 20,000 b/d refinery planned in Tunisia by Ente Nationale Idrocarburi will be at Bizerte rather than La Skhira as planned originally.

• • •

Under construction—a new 100,000 b/d refinery at Mina Abdullah, Neutral Zone, by American Independent Oil Co., for completion early in 1962; contractor is Ralph M. Parsons Co. This is a new plant, in addition to Aminoil's existing 40,000 b/d refinery at the site. An unique feature of the crude storage area is an already-completed 605,000 bbl tank, built to facilitate unloading 85,000 dwt class tankers which can carry 550,000 bbl of oil. Measuring 260 ft in diameter by 64 ft high, the floating roof tank was built by Chicago Bridge Ltd.

• • •

Planned—expansion of the 4,000 b/d refinery of Cia. Petroleos de Angola at Luanda, Angola, to about 10,000 b/d, with completion end of 1961.

• • •

Completed—a 20,000 b/d delayed coking unit at Beaumont, Texas, by Mobil Oil, boosting the company's total coke-making capacity to 3,300 ton/day. The new unit produces up to 800 ton/day.

• • •

Planned—a new $14 million, 84,000 b/d UOP fluid catalytic cracking unit, at Sun Oil Co.'s Marcus Hook, Penna., refinery, replacing a 21-year-old fixed-bed unit, for completion in October, 1962.

• • •

Completed—the $12.5 million, 326 mmcf/d natural gas processing plant in the Rimbey field of Alberta, to be operated by British American Oil Co. Ltd., a major share owner with 26 other firms. Products will include 280 mmcf/d sales gas, 86,000 gal/day propane, 112,000 gal/day butane, 12,600 b/d condensate, and 250 ton/day sulfur. A pipeline is to be built to carry condensate to B-A refinery at Edmonton.

What's New in Petrochemicals

Contract awarded—to Badger N.V., by N.V. Chemische Industrie Synres (50% owned by Allied Chemical Co.), for design, engineering, and construction of a phthalic anhydride plant at Hoek van Holland, Netherlands, for completion the fall of 1962.

• • •

Approved—by Indian government, proposal by Esso Standard Eastern for a 100,000 ton/yr petrochemical plant at Trombay, India, to operate on naphtha feed from Stanvac refinery and produce ethylene, propylene, benzene, and others. Esso will establish a new firm (50% Indian government owned) to operate the plant. Authorized capital is $10.5 million.

• • •

Contracts awarded—to three German firms, Friedrich Uhde, Ferrostaal, and Hochtief, to build a 70,000 ton/yr $15.5 million ammonium nitrate plant at Cuzo, Peru, with completion planned in three years.

Planned—a polyurethane plant at Cassino, Italy, by Montecassino SpA, a new company formed by Houdry Process Corp. and Cia. Internazionale Generale Industriale—Malatesta SpA (CIGI) as an equal partnership. Plant completion is expected late this year.

• • •

Approved—by Assam state government, proposal by Assam Gas Co. to build natural gas products plant operating on about 100 mmcf/d and turning out (in 1,000 lb/yr): ethane, 342; propane, 856; isobutane, 780; pentane, 500; for completion mid-1963.

• • •

New company established—Daikyowa Petrochemical Co., by Daikyo Oil Co. and Kyowa Fermentation Industry Co., to operate the $20 million petrochemical complex planned for Yokkaichi, Japan, near Nagoya. Project, using a new process developed by Kyowa, is to be designed by Stone & Webster Engrg. Corp.

• • •

Planned—a 70,000 ton/yr phenol-acetone plant at Sassari, Sardinia, by Italiana Resine Gulf SpA, a new company organized in Italy by Gulf Oil Corp.

• • •

Planned—a 10,000 ton-yr polybutadiene plant in Japan, by Asahi Chemical Co., pending government approval, plant to be licensed by Firestone.

• • •

Under construction—a 35,000 ton/yr urea plant at Fort Saskatchewan, Alberta, by Sherritt Gordon Mines Ltd., with completion expected late in 1962.

• • •

Planned—a 33 million lb/yr, $4 million carbon black plant at Salamanca, Mexico, by Negromex S.A., to be licensed by Phillips.

• • •

Planned—a $3 million, 4,000 ton/yr vinyl chloride and polyvinyl chloride plant at Haifa, Israel, for completion late in 1962.

Planned—a $23 million urea and ammonium sulfate facility on Mindanao, Philippines, by Marinduque Iron Mines Agents Inc. Contractor for construction is Foster Wheeler.

• • •

Planned—a $4 million carbon black plant at Rantau, Indonesia, by P. T. Permina, a government company.

• • •

Planned—a 100 million lb/yr, multi-million dollar naphthalene plant at Port Arthur, Texas, by Texaco Inc., with completion late 1962 or early 1963.

• • •

Planned—a $10 million nitrogen products plant at or near Clinton, Iowa, by Hawkeye Chemical Co., a new firm established by Swift & Co. and Skelly Oil Co.

• • •

Under construction—a 30 million lb/yr phthalic anhydride plant, by Oronite Division of California Chemical Co., at the California Oil refinery in Perth Amboy, N. J.

• • •

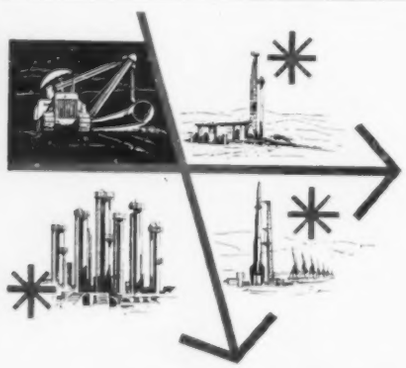
Planned—a 50 million lb/yr naphthalene plant at East Chicago, Ind., by Cities Service Co., with completion expected by mid 1962.

• • •

Planned—a $4 million petrochemical plant near Bombay, India, by Struther Wells International Corp., who will design, build and operate it jointly with the Indian firm of Napara Engineering Co.

Argentina Visitors In Houston

Shown are recent visitors to the Houston manufacturing plant of Axelson-Garrett Division of U.S. Industries. Looking on as Axelson-Garrett's W. K. Woodward explains testing of an A-G relief valve are: Ricardo Hiba—Clark Brothers, New York; Antonio Ottati—Gas Del Estado De Argentina; Ricardo F. Napal—Gas Del Estado De Argentina; Pedro R. Casasola—Gas Del Estado De Argentina, and C. R. Apitz—Clark Brothers, Houston.



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New Technology Boosts Markets for Petrochemical Toluene

(Continued from page 62)

under further distillation to form a difficultly removable deposit on the walls of the distillation vessel.

One approach [15] to overcoming this problem calls for flash distillation of the residual diisocyanate. The distillation heel is heated under pressure to 200-300 C and is then introduced into a low-pressure zone. As a result, contained isocyanate is flashed off and can be recovered by condensation. The residue is converted thereby into a dry friable solid which can be readily removed from the vessel. Its toluene diisocyanate content is reported to be in the range of 3-4%.

Miscellaneous New Uses: Terephthalic acid may be produced from toluene via potassium benzoate by the Henkel route, outlined above (note, however, that the preferred raw material in the Henkel process is potassium phthalate).

Two other toluene-consuming syntheses of terephthalic acid have been investigated on a pilot-plant scale.

Recent interest has been aroused in one of these, developed by Germany's Bergbau-Forschung GmbH.[20] First step in the process is chloromethylation of toluene by reaction with paraformaldehyde in the presence of 33% muriatic acid at 70 C. The conversion is carried out in two stages set in series.

The resulting crude organic product is a mixture of chloromethyl toluenes, containing some 57% of the desired para isomer. Following its separation from the aqueous organic layer, the crude organic product is oxidized by 44% nitric acid at about 95 C to yield toluic acids which are further oxidized to terephthalic acid and phthalic anhydride.

Another route from toluene to TPA, developed by VEB Hydrierwerk Zeitz [23] involves reaction of toluene with carbamyl chloride ($CONH_2Cl$) in the presence of aluminum chloride to form p-toluamide in approximately 90% yield. The product is saponified by 16% caustic soda and the resulting p-toluic acid is oxidized by potassium permanganate for an overall terephthalic acid yield of 70-75%. Oxidizing agents other than permanganate appear of more interest for the oxidation of toluic acid, however, in accordance with established commercial practice.

Indications are that the circuitous chloromethylation and carbamylation routes from toluene to TPA will be hard-pressed to compete with p-xylene oxidation. Some commercial attractiveness in the toluene-based disproportionation route to TPA (Henkel process) is evidenced by current construction in Japan of a commercial plant based on this method.

The foregoing discussion has been concerned with the new technology which promises growing demand for toluene as petrochemical raw material. In considering the overall field, however, the established derivatives—TNT, chlorinated toluenes, vinyl toluene, benzaldehyde, benzonitrile, etc. must be given due consideration.

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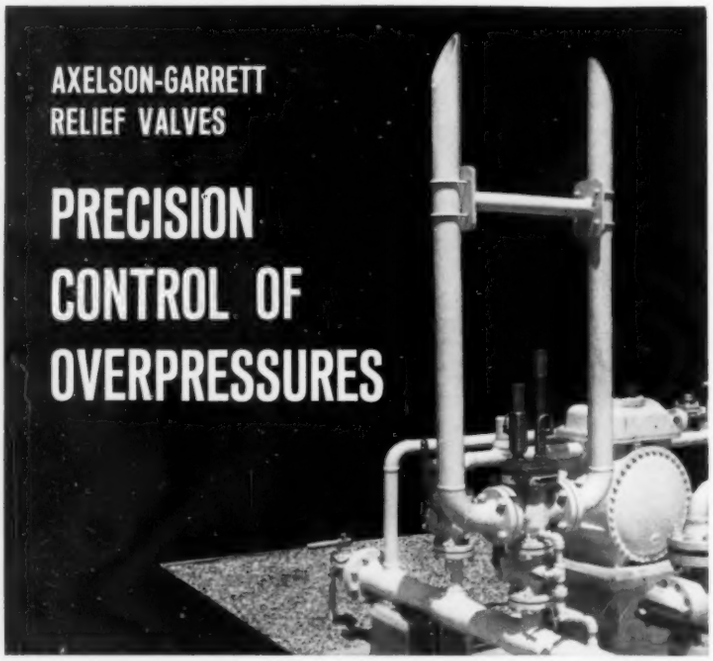

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Tanker Corrosion Prevention

(*Continued from page 54*)

Further progress in another use of zinc —as anodes in a cathodic protection system in ballast tanks—was also discussed at the API tanker conference. The scheme, a development by Socony Mobil Oil, had first been reported at the 1959 conference (see WORLD PETROLEUM, October, 1959, p. 50).

A system was installed in a new tanker, the SS "Mobil Aero," in March, 1959, and was evaluated after two years of service in clean product U.S. coastal trade. Corrosion rate in the ballast tanks protected with the zinc anode system was greatly reduced, with data indicating a six-year anode life. Direct costs for this protection have been between $1,200 and $2,000 per year per tank across. A possible modification of the attachment method for the anode to reduce installation cost is being considered.

The Socony Mobil tests showed there was an indirect gain to be had in the non-anode tanks in addition to the reduction in corrosion in the ballast tanks. With the incentive to ballast the anode tanks, the tanks without anodes are ballasted less often. Company inspections in a number of ships indicate that corrosion in non-anode tanks is lower by reducing ballast time.

Further reduction in corrosion in both ballast and non-ballast tanks has resulted from using fresh water to rinse the tanks after any exposure to sea water. END

Traveler's Aids

"Instant" travel directions are the latest service for patrons of the New Jersey Turnpike these days. The source is the Directomat, an automated electronics device installed by Cities Service, in cooperation with the New Jersey Turnpike Authority, at service area 10-N, near Woodbridge, New Jersey.

The robot device—the first of its type ever used at a service station—is designed to answer clearly and quickly the routine questions asked by the thousands of Turnpike motorists who stop at the Touring Bureau for travel information. At the touch of a button, the answer to any one of 120 pre-set questions is provided within seven seconds. The answers are printed on small slips of paper, easy to carry in wallet or purse for later reference.

Mannesmann's Diamond Jubilee

The diamond jubilee of the seamless steel pipe was feted recently in its native town of Remscheid with a huge celebration at the Remscheid Pipe Works of Mannesmann A.G., near Duesseldorf in West Germany. Leading officials and industrialists attended the ceremony, held 75 years after Reinhard and Max Mannesmann succeeded in making the first seamless pipe out of a block of steel on Aug. 8, 1866, after long and persistent efforts.

The two brothers' invention, further improved a few years later by the introduction of pioneering manufacturing methods at Remscheid, led to a revolution in pipe manufacture and pipeline construction. It is credited with contributing in large measure to the expansion of the oil and gas industry.

Their firm today is one of the biggest of West Germany's Ruhr industries and heads an international complex of 30 companies in 17 countries, doing an $800 million-a-year business.

In the United States, Mannesmann firms include the American Mannex Corp., New York, its Easton (Pa.) Metal Powder Division, Mannesmann-Easton Plastic Products Co., Inc., Easton, Pa., and Mannesmann-Meer, Inc., Youngstown, O. In Canada, Mannesmann operates a $25 million automated tube mill at Sault Ste. Marie, Ontario, and the Canadian Mannex Corp. at Calgary, Alberta.

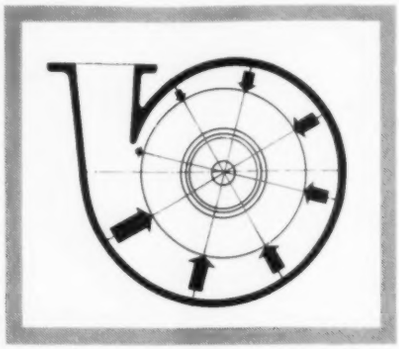
New Geolograph Recorder

A new 4-Pen Recorder, now available from Geolograph Oil Field Services, promises to be of great assistance to the oil man wishing more recorded data regarding rig activities which occur while drilling. The Geolograph Recorder Model G7TPW records penetration rate, downtime, rotary torque in foot pounds, pump pressure in psi and weight in thousands of pounds, all on a chart only 7" wide.

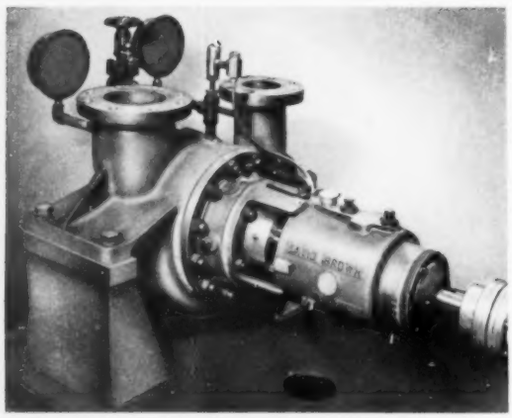
CB&I Appoints Penna

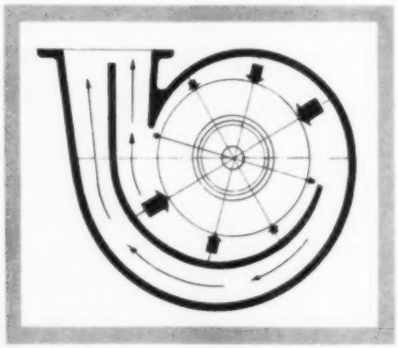
Geraldo O. Penna has been appointed director of sales promotion for South American operations of Chicago Bridge & Iron Co., world-wide steel plate fabricating and construction firm. Penna will be in charge of an area including the countries of Argentina, Bolivia, Brazil, Chile, Ecuador, Paraguay, Peru and Uruguay. In addition to his new duties, he will continue as manager of Chicago Bridge Construcoes Ltda., CB&I's subsidiary in Brazil.

Why HYDRAULIC RADIAL BALANCE makes so much difference to the life of a centrifugal pump



See how the outdated single volute construction promotes uneven pressure around the periphery of the impeller, causing excessive bearing wear, excessive maintenance, excessive costs !





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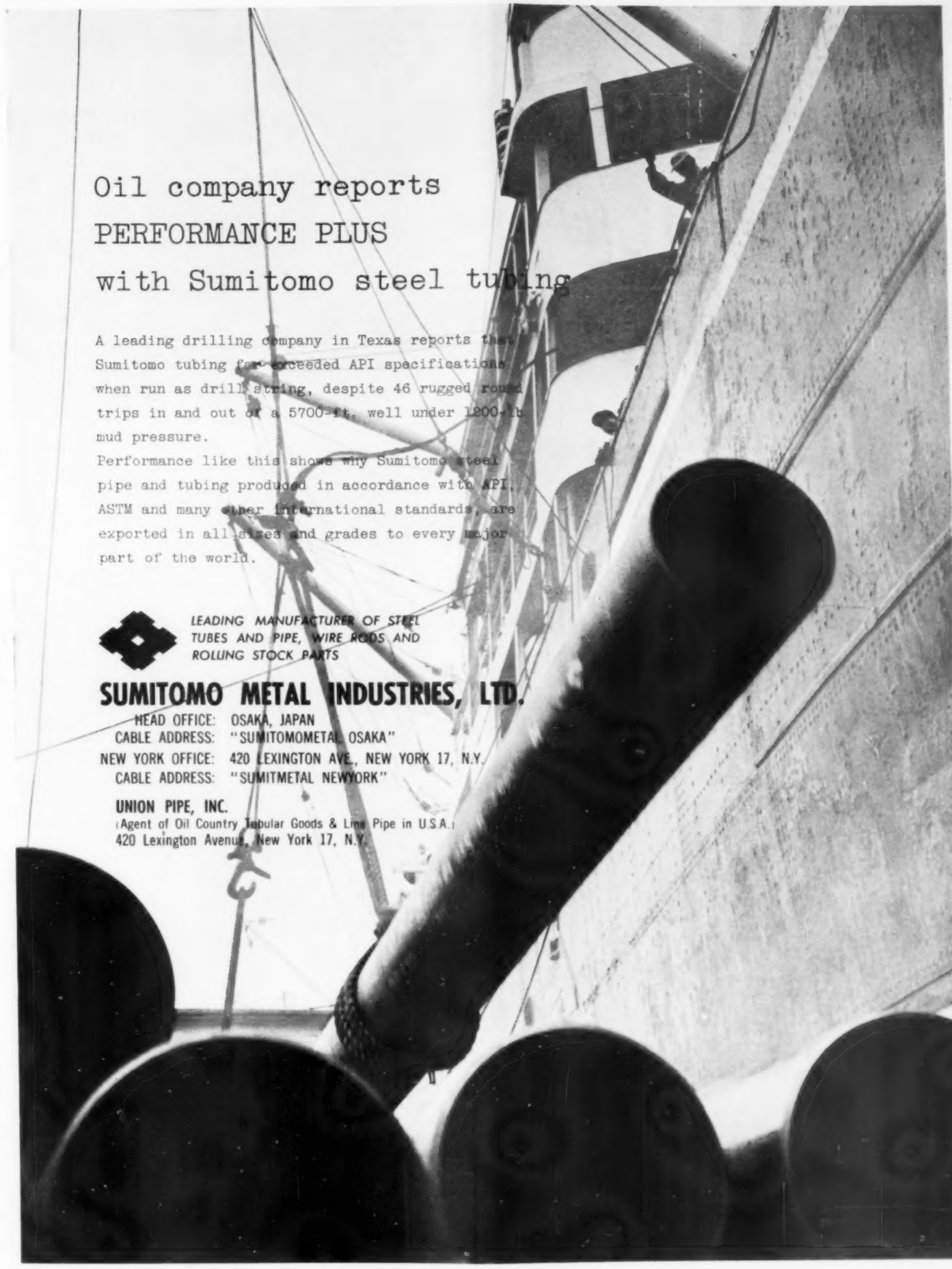

Oil company reports PERFORMANCE PLUS with Sumitomo steel tubing

A leading drilling company in Texas reports that Sumitomo tubing far exceeded API specifications when run as drill string, despite 46 rugged round trips in and out of a 5700-ft. well under 1200-lb mud pressure.

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Magcobar in Greece & Germany

With the completion and start-up of new processing facilities on the Island of Myconos, Greece, finished Magcobar barite weight material and bentonite are now available from that point to drilling operations in the Mediterranean area, Africa, and the Middle East. Magcobar, with headquarters at Houston, Texas, is one of the Dresser Industries, a Dallas-based oil field equipment supplier.

The new facilities were constructed as part of an expansion of a barite mining operation that was originally begun on Myconos in 1955. Prior to the current expansion, crude barite was mined and washed on Myconos and then shipped to Magcobar facilities in the United States for processing into finished product. With the new facilities, complete barite and bentonite processing operations will take place on Myconos.

A new organization called the Magcobar Division of Dresser (Germany) GmbH has been established to market Magcobar drilling mud products in West Germany. Johannes Hubert Kuckertz, who has wide experience in the oil well drilling industry in the United States and Europe, has been named manager of the Magcobar Division. Headquarters of the new organization will be located at Drakenburg 293/Kreis.

Dresser Elects

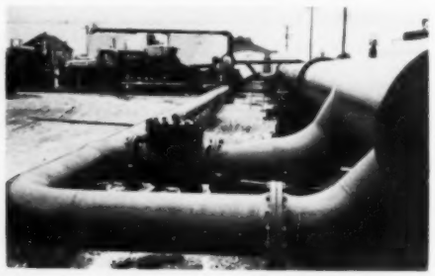
Dresser Industries, Inc., has elected John P. Cartwright as vice president, machinery group. Cartwright comes to Dresser Industries from Joy Manufacturing Co. where he was a vice president and general manager of the industrial division. Mr. Cartwright will headquarter in the Dresser Industries' Dallas office.

Dow Appointment

Frederick W. Dow has been named manager of the New York office of Dow Chemical International S.A. Dow's new appointment is a project assignment and is effective October 1. He succeeds Jack A. Dorland, who was recently named a consultant after having completed thirty years with the company.

Borg-Warner Elects

Alonzo B. Kight has been elected president of Borg-Warner International Corp. Kight has been associated with Borg-Warner since 1948, serving first as a patent attorney for the parent company and later as Administrative Assistant to the President. In 1955 he was elected vice president of Borg-Warner International, the position he held when his new post was announced. This subsidiary handles the overseas manufacture, licensing and export of Borg-Warner products.



Large Piston Prover Built

What is thought to be the largest piston pipe prover system ever built has been completed by J. A. Halpine & Son, Inc., of Tulsa. The prover barrel consists of a 36-inch steel tube, 160 ft long with a 16-inch manifold valve that directs the flow. The prover has undergone two days of testing with power pumps and crude oil being provided by a Tulsa oil well servicing firm.

The system will be disassembled, crated and shipped to an American oil firm operating in Libya. Alone with this will be a smaller one with a 20-inch piston tube and 105 ft in length.

Components of the system include a Halmor tachometer or pulse generator driven by the meter that generates 1,000 pulses per revolution of the meter shaft; a piston barrel and associated switching manifold, two Halmor piston switches, one electric counter and finally, the meters that require calibration.

Halmor Liquid-Meter Prover Systems permit positive-displacement meters to be proved within a few minutes and eliminates start and stop errors. The Halpine company manufactures models to handle meters of all sizes, at working pressures up to 1,200 psi, and flow rates to meet all requirements.

Directional Turbodrill

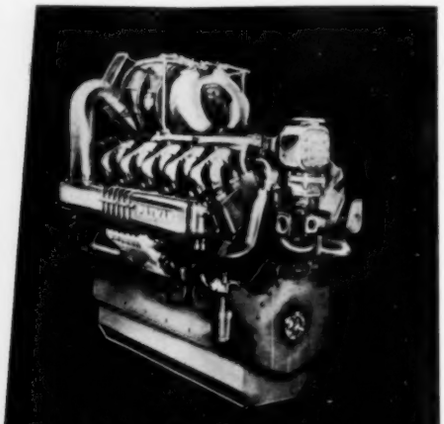
Eastman Oil Well Survey Co., Denver, has completed a successful run of a directional turbo-drill in the United States. Based on the experience of its subsidiary in Germany, and extensive research, Eastman has developed a technique for using the turbo-drill controlled by a specially designed deflection method. The field tests now in progress are part of an evaluation program by Eastman to determine the economics of using the turbo-drill for directional drilling as applied to domestic drilling conditions.

HAROLD BELL

Harold Sill Bell, a consulting engineer specializing in petroleum, died recently after a long illness. His age was 72.

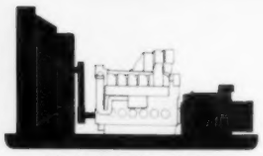
Mr. Bell began his business career with the Vacuum Oil Co. becoming finally, acting chief engineer of the company's manufacturing activities. In World War I, Mr. Bell was employed by the Navy in the construction of docks, storage and fueling facilities. After serving as advisory engineer to the board of the Sinclair Consolidated Oil Co. and as manager of the oil division of the M. W. Kellogg Co., he organized H. H. Bell, Inc., petroleum engineers. In 1935 he set up an affiliated company, Compagnia Tecnica Petroli, in Italy. He entered government service as a petroleum consultant to the Board of Economic Warfare. In 1948, Mr. Bell joined the Frederick Snare Corp. of New York, to assist in the design and construction of oil and allied projects. Upon retirement from that concern, he maintained offices in Newark and later in Summit, N. J. as a consulting engineer.

Tomorrow's deep drilling venture

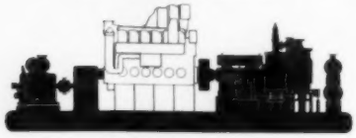


... will include a 'VENTURA'

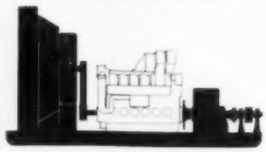
When deeper drilling calls for greater power at the rig—and increased acceleration for knocking hours off round-trip times—the oilman's first choice is the Paxman 'Ventura'. To work deep deep down . . . beyond the 25,000 foot mark . . . these rugged engines not only give more power and faster acceleration, but give it **without any increase in size or weight.** Powerful, compact, lightweight 'Ventura' diesels still retain maximum accessibility . . . combine these outstanding features with a best ever power weight ratio and the absolute dependability you would expect from Paxman's world wide experience of power drilling applications.



Mechanical drive with torque converter and fluid coupling.



Compressed air drilling.



Diesel-electric drive

Paxman 'Ventura' diesels are application engineered for the oilfields in three standard arrangements.

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PO.10

a new diesel power unit for industry

51 B.H.P. AT 2,000 R.P.M.

Perkins announce the introduction of a low priced power unit designed to meet the power requirements of a wide variety of industrial, construction and agricultural operators, The Perkins Four 203(D) incorporates a four cylinder engine housed in a good looking, easy-to-get-at tractor type canopy. The use of components already in quantity production enables Perkins to produce the FOUR 203(D) at a really low initial cost.

This new power unit has a maximum torque of 156 lbs. ft. at 1,200 r.p.m. and has an intermittent rating of 51 b.h.p. at 2,000 r.p.m. Amongst the wide variety of rear-end arrangements are nine friction clutches, a flexible coupling and a solid power take-off. If you would like to know more about this important new addition to the Perkins range, please fill in the coupon.

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Please send me full details of your new
FOUR 203 (D) POWER UNIT

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Cities Service Buys Columbian Carbon

Cities Service Co. and Columbian Carbon have merged. Each company will continue to carry on its principal activities with present management and personnel. Shareholders of Columbian Carbon receive, for each share of their stock, sixty-seven one-hundredths of one share of no par value, cumulative convertible preferred stock to be issued by Cities Service Co.

The Cities Service preferred stock will carry a dividend of $4.40 per share and will be non-callable for five years. It will be convertible into Cities Service common stock on the basis of one share of preferred stock for each one and sixty-three one-hundredths share of Cities Service common stock.

Houston D&D Elects

Miss Eleanor Wirfel, secretary to Fred J. Heyne, Jr., of King & Heyne, has been elected president of the Desk & Derrick Club of Houston for the year 1961-1962. Other officers are: Mrs. Earlene Monroe of Butler, Miller & Lents, 1st vice president; Mrs. Ann A. Fontenot, Delta Tank Manufacturing Co., Inc., 2nd vice president; Miss Gladys Jurchak, Transco Gas Pipe Line Co., recording secretary; Miss Claire See, Texaco, Inc., corresponding secretary; and Miss Elizabeth Quick, J. Brown Cutbirth, treasurer.

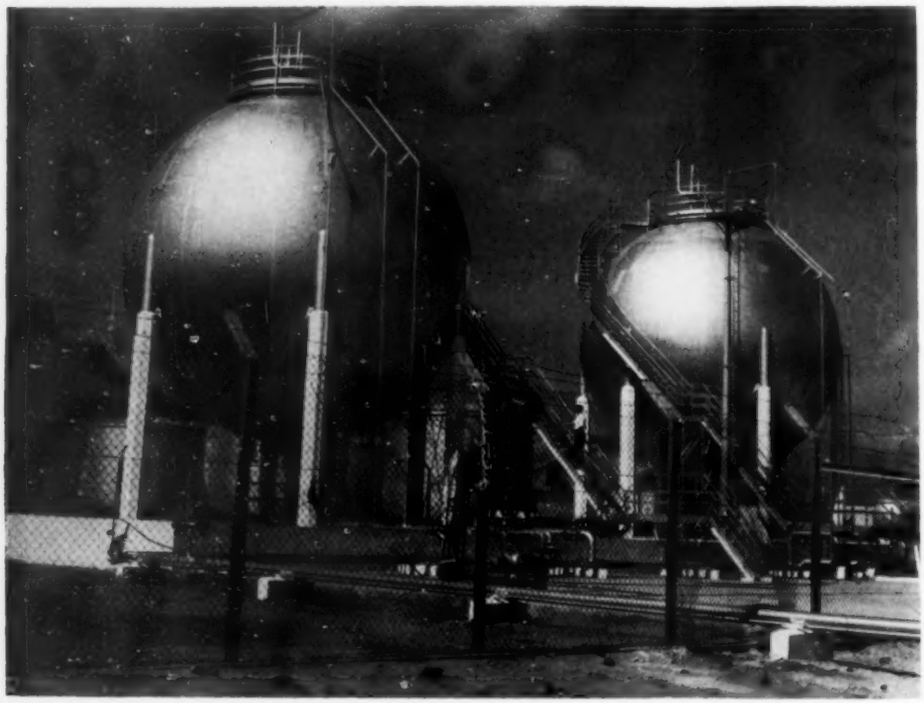
The Houston club, one of the four charter clubs of the Association of Desk & Derrick Clubs of North America, was hostess of the annual ADDC convention in September.

Ohio Buys Terminals

The Ohio Oil Co. has purchased the common stock of Petroleum Terminals, Inc., Chicago, for an undisclosed cash amount. The transaction became effective July 15, 1961, converting Petroleum Terminals into a wholly-owned subsidiary of Ohio Oil.

Incorporated in 1952, Petroleum Terminals is a wholesaler of light petroleum products, including gasoline and fuel oil, in portions of Illinois, Indiana, Wisconsin, and Michigan.

CONTRACTORS TO THE OIL INDUSTRY



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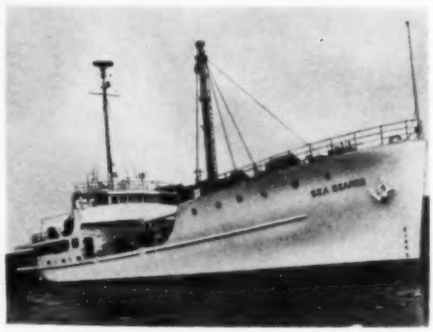

"Sea Search" en route to Africa

The "Sea Search," newest addition to the fleet of three ocean-going seismic exploration vessels owned by Geophysical Service Inc. of Dallas, is currently on a 2,500-mile voyage from Trinidad to the Spanish Sahara on the northwest coast of Africa.

GSI President R. C. Dunlap, Jr. said the vessel has recently completed a petroleum exploration contract in the Gulf of Paria off Trinidad and will perform a similar survey in the waters of the Spanish Sahara where interest in petroleum exploration has been growing over the past year.

The "Sea Search" is a sister ship to GSI's "Sonic" and "Texin." The "Sonic" is presently en route through the Mediterranean Sea to a contract in the Persian Gulf and the "Texin" is working off the coast of Brazil.

J. L. Patton

Patton Appointed by Kellogg

James L. Patton has been appointed manager of the refinery process division by The M. W. Kellogg Co., New York, a subsidiary of Pullman Inc.

A member of M. W. Kellogg since 1944, Patton served as a refinery division process manager and, more recently, as manager of the Chemical Process division. A graduate of the University of Tennessee and a member of the AIChE and Tau Beta Pi, he is licensed as a professional engineer by the states of New York and Texas.

BP Develops Hydraulic Drive

A new hydraulic transmission system for oil well drilling equipment has been developed by BP Exploration Co.'s drilling branch. This transmission system has been designed to meet special requirements of BP's associate company, Abu Dhabi Marine Areas Ltd. For these purposes a well-servicing outfit with a fully flameproof and remotely powered drive was needed.

With the new system, a conventional draw-works is used but in place of the normal mechanical chain drive, power from the diesel engine is transmitted hydraulically through a 3½-inch-diameter flexible hose. BP Energol HL80 hydraulic oil is used.

When this newly developed outfit is in use for offshore well servicing, the diesel power unit will be placed on the deck of a work barge and linked by pipe and hose to a draw-works mounted on the helicopter deck of the wellhead platform some 200 ft away. The outfit has been developed in association with the Oil Well Engineering Co.

Davidson Promoted by Norris

Wm. L. Butler, president of the W. C. Norris Division of Dover Corp., has announced the appointment of G. W. "Bill" Davidson to the position of executive vice president.

Mr. Davidson has served in many executive positions since joining the firm 26 years ago. For the past eight years he has served as vice president in charge of sales.

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The name that counts in High Pressure

Ermeto high pressure valves are available in many types and sizes for use with a wide variety of liquids and gases. Standard valves incorporate Ermeto end connections and thus simplify their installation in high pressure circuits. All Ermeto valves are individually tested to one and a half times their working pressure before leaving the works.
The valves are manufactured in mild steel, stainless steel and high duty bronze.
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BRANTLY ROTARY DRILLING HANDBOOK

For the sixth time in the past quarter of a century J. E. Brantly and his staff of expert engineering editors have completely rewritten the Brantly Rotary Drilling Handbook to cover new developments in the equipment and technology of drilling.

The new edition is more than 20 percent larger than its most recent predecessor. Illustrations including practical nomographic charts and performance curves have been increased from 122 to 603 in the new edition.

Bound in sturdy black fabricoid with rounded corners for long service at the rig as well as in the office, **the new sixth edition is now ready for shipment at $12.50 per copy, postpaid.**

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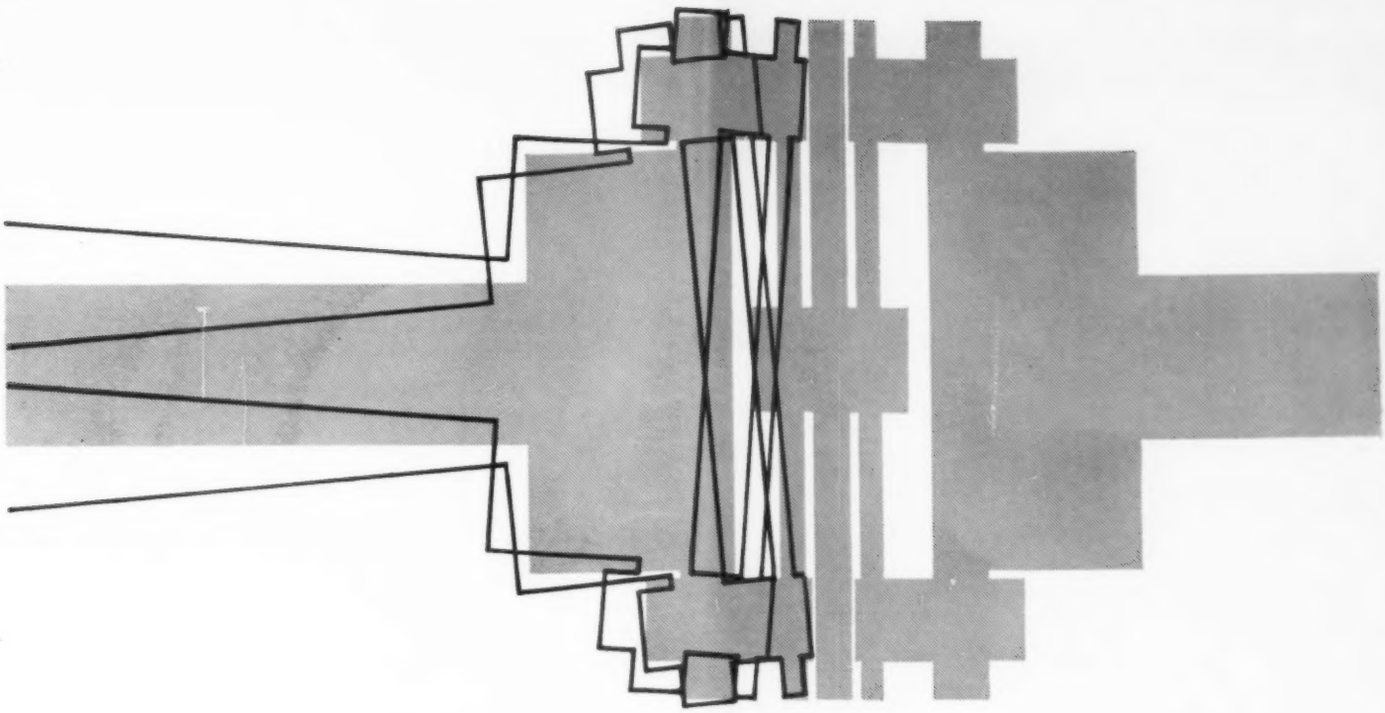

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A power transmission coupling having all the merits and advantages that are inherent in the unique Metastream design, and available at

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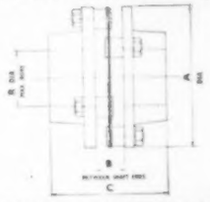
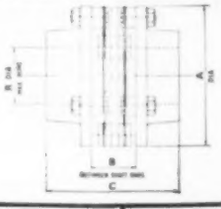
THE MOST OUTSTANDING VALUE EVER OFFERED

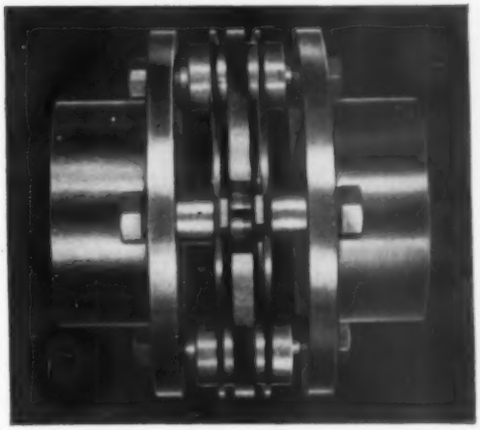
Supplied in spacer, non-spacer and single and double bank-types, ex stock

SINGLE BANK TYPE 'S'



DOUBLE BANK TYPE 'D'





Specification Table

Size of Coupling	Max. Rating Hp/Rpm	A	B	C	R Max. Bore
D.I.S. 1/S	.002	$1\frac{7}{8}$"	0.477"	1.477"	$\frac{5}{8}$"
D.I.S. 3/S	.005	3.45"	0.6125"	2.8625"	$1\frac{1}{4}$"
D.I.S. 6/S	.010	$4\frac{13}{32}$"	0.83"	3.83"	$1\frac{3}{4}$"
D.I.S.12/S	.020	$5\frac{31}{32}$"	$\frac{29}{32}$"	$4\frac{13}{32}$"	$2\frac{1}{8}$"
D.I.S.24/S	.040	$6\frac{31}{32}$"	$\frac{7}{8}$"	$5\frac{7}{8}$"	$2\frac{3}{4}$"

Size of Coupling	Max. Rating Hp/Rpm	A	B	C	R Max. Bore
D.I.S. 1/D	.002	$1\frac{7}{8}$"	0.93"	1.93"	$\frac{5}{8}$"
D.I.S. 3/D	.005	3.45"	1.125"	3.375"	$1\frac{1}{4}$"
D.I.S. 6/D	.010	$4\frac{13}{32}$"	$1\frac{7}{16}$"	$4\frac{7}{16}$"	$1\frac{3}{4}$"
D.I.S. 12/D	.020	$5\frac{31}{32}$"	1.764"	5.264"	$2\frac{1}{8}$"
D.I.S. 24/D	.040	$6\frac{31}{32}$"	"1.792	6.792"	$2\frac{3}{4}$"

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P.6905

OIL COMPANY STAFF CHANGES

R. O. Goodykoontz

W. W. Bryan

E. D. Loughney

D. L. Campbell

ROBERT O. GOODYKOONTZ, general manager of Humble Oil & Refining Co.'s central region, has been named vice president in charge of the Esso Standard, eastern region, of Humble, effective, January 1. **WILLIAM W. BRYAN,** Humble's vice president for marketing, who has also headed the Esso Standard region for the past year, has returned to his primary duties in Houston.

HENRY H. BEESON has been named to head a newly established natural gas section of Mobil Oil Co.'s exploration and producing department in New York. The new section will perform the functions of the present natural gas manager in New York and the natural gas coordinating office in Dallas.

N. V. HAKALA, deputy to vice president W. J. Sweeney of Esso Research and Engineering Co., Linden, N. J., has been appointed managing director and elected to the board of directors of Esso Research Ltd., Abingdon, England. He succeeds **C. S. WINDEBANK,** who has been made vice chairman of Standard Oil Co. (N.J.)'s new uses activity. Dr. Hakala joined Esso 18 years ago after receiving his Ph.D. in chemistry from the University of Wisconsin.

FREDERICK W. ATHERTON, of Wellesley, Mass., will join Continental Oil Co. about November 1, and will be concerned chiefly with analytical appraisal of company operations and projects from the point of view of shareholders and company relations with the investment community.

His headquarters will be at Continental's offices in New York City, and it is contemplated that he will be elected a vice president when he comes with the company.

Mr. Atherton has been the oil industry research specialist for the Boston-based investment counsel firm of Loomis, Sayles & Co., since 1931, and the partner in charge of the oil department since 1946. He is a director of the Loomis-Sayles Fund of Canada, Ltd.

R. J. LOEFFLER has been appointed assistant producing advisor for Standard Oil (New Jersey) the European/Mediterranean areas. Mr. Loeffler, a geologist by profession, most recently has been employed by Humble Oil & Refining Co. during the past three years. Previously he worked for Creole Petroleum Corp. in Venezuela for a period of fifteen years.

ALLEN GRAVES, formerly with the geological department of Mobil International, has been appointed as head of the Kuwait International Oil Co. This company was formed by the government of Kuwait and is owned 60% by the government, with the remaining 40% owned by Kuwait private citizens.

H. W. MAGEE has been appointed petrochemicals representative for Gulf Oil Corp. and its subsidiary, Transocean Chemical Co., with offices in Milan, Italy. Mr. Magee has been in London as special representative—European activities for the petrochemicals department of Gulf. In his new assignment, Mr. Magee will provide technical and business liaison for Gulf Oil and Transocean Chemical with Societa Italiana Resine-Gulf, a newly formed joint company which is constructing a plant to produce phenol on the island of Sardinia.

R. JACK HAWES, former supervisor of technology at Tidewater Oil Co.'s Delaware refinery, has been promoted to superintendent of technology. He succeeds Dr. Arthur W. Lewis, who has been named to an assignment at the company's home office in Los Angeles.

Three British American officers have been appointed to the board of directors of Shawinigan Chemicals Ltd. They are: **E. D. LOUGHNEY,** B-A president; **D. L. CAMPBELL,** executive vice president; and **J. W. MORGAN,** vice president.

J. W. Morgan

J. L. Carr

JOEL L. CARR has been named general attorney for The Atlantic Refining Co., at Philadelphia. He has been a member of Atlantic's legal department since September, 1951.

MORGAN J. DAVIS has been elected board chairman of Humble Oil & Refining Co. and **CARL E. REISTLE, Jr.,** now executive vice president, succeeds Davis as president of the company. The office of board chairman is a recently created position in the new Humble Oil & Refining Co., which became a nationwide organization on January 1, 1960.

RICHARD WAGNER, chairman of the Executive Committee of Champlin Oil & Refining Co., Chicago, has been appointed by U. S. Secretary of Commerce Luther H. Hodges to the National Export Expansion Committee, formed to promote sales of USA goods and services in markets abroad.

Oilman Wagner, who is president of the Chamber of Commerce of the United States, was business adviser to the American delegation to the 13th session of the General Agreement on Tariffs and Trade (GATT) in Geneva, Switzerland.

JACK P. REID, Ponca City, Okla., refinery process engineer for Conoco, appointed chief process engineer for Refineria Panama, which is owned jointly by Continental Oil Co. and National Bulk Carriers. **ERNESTO C. SEGUNDO,** New York, international sales representative for Conoco's petrochemical department, appointed Central America sales manager for Refineria Panama. **DUANE MacFARLAND,** New York, advertising and sales promotion manager for Conoco's petrochemical department, appointed assistant to the executive vice president of Refineria Panama.

FRED H. MOORE, executive vice president of Mobil Oil Co., elected to the board of directors of Magnolia Pipe Line Co.

JOHN H. THACHER has been appointed to a new executive assignment in the management of Standard Oil Co. of California with responsibility over the company's interests in the Huntington Beach Co. and the Elk Hills Naval Petroleum Reserve.

CHARLES REID GAYLORD has resigned as director and senior vice president of Signal Oil and Gas Co.

STUART K. CLARK, petroleum geologist, has retired after nearly 38 years of service with Continental Oil Co. Mr. Clark joined Conoco at Ponca City, Okla., in 1924. He became coordinator of exploration activities in 1948, and was named manager of the royalty department in 1951 and manager of the foreign department two years later. He became assistant to the vice president and general manager of the international exploration and production department in 1957 and has served as a consultant to that department during the past three years.

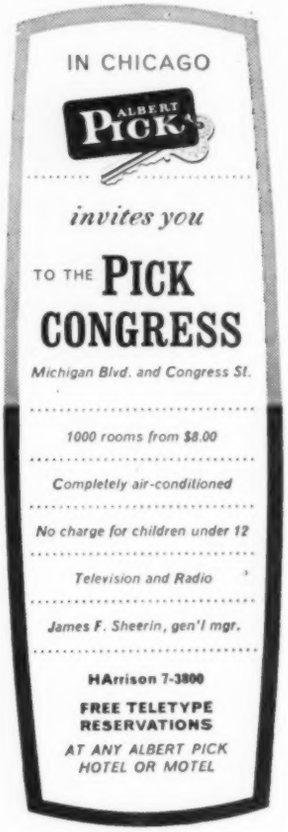
As an exploration executive, he has traveled extensively, and as manager of Conoco's foreign department, he served as a director of Conorada Petroleum Corp., a company affiliate, and as an officer and director of several additional foreign subsidiaries.

WALTER R. FEHR

Walter R. Fehr, former chief geologist and geological advisor of Anglo-Egyptian Oilfields Ltd., died at Maennedorf, Switzerland, of a heart attack in his 67th year, on July 21. A native of Switzerland, Dr. Fehr obtained his formal education at the University of Berne and at the Ecole des Mines, Paris. He was associated with Royal Dutch/Shell and affiliates throughout his career, in Mexico, the U.S.A., most of South America, Egypt, and the Near East. Following retirement in 1948 to his home near Zurich, he again did some field work in an advisory capacity in Israel, and then returned to Switzerland, where he had recently begun to take an active interest in oil exploration in his own country.

HERMAN JACOBSON

Herman Jacobson died peacefully in Wassenaar, Holland, on August 3, while on a visit to his homeland. Mr. Jacobson was one of the pioneers of the international petroleum and petrochemical industry. Born in Amsterdam on March 11, 1882, he started his career in Romania where he represented the interests of Royal Dutch Shell, a position he held until the end of World War I. He subsequently served the Royal Dutch Shell Group in a number of other executive capacities in various parts of the world. Herman Jacobson retired from active Shell service in 1947 although he stayed on for several more years in an advisory capacity. He was an Honorary Consul of the Netherlands and an officer of the Order of Orange Nassau, a decoration bestowed on him by the Queen of the Netherlands.



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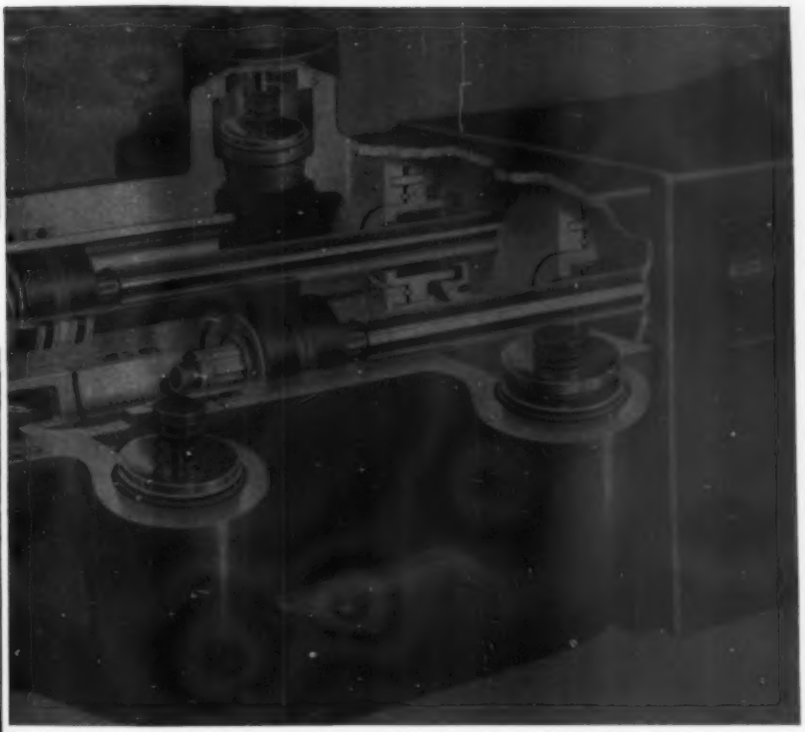
they spell higher pumping efficiency even when worn



The Mud Monarch® for high pressures lasts longer and does a better job to the very end The important thing to remember about the Mud Monarch valves and seats is the exclusive seal ring. This seal ring is unaffected by wear on both valve and seat. There is no fluid slippage, no imperfect closing due to sand or foreign material. For low and medium pressure pumps, Mission Super-Service® and Silver Top® valves will last longest. Their heavy forged alloy steel bodies have high corrosion fatigue strength and are able to resist cyclic stresses set up by loading and unloading. The Compound 308® inserts offer greatest resistance to the chemical and abrasive effect of the fluid. For any pressure, any pump, Mission pump parts are the industry's first choice for longer life, less trouble.

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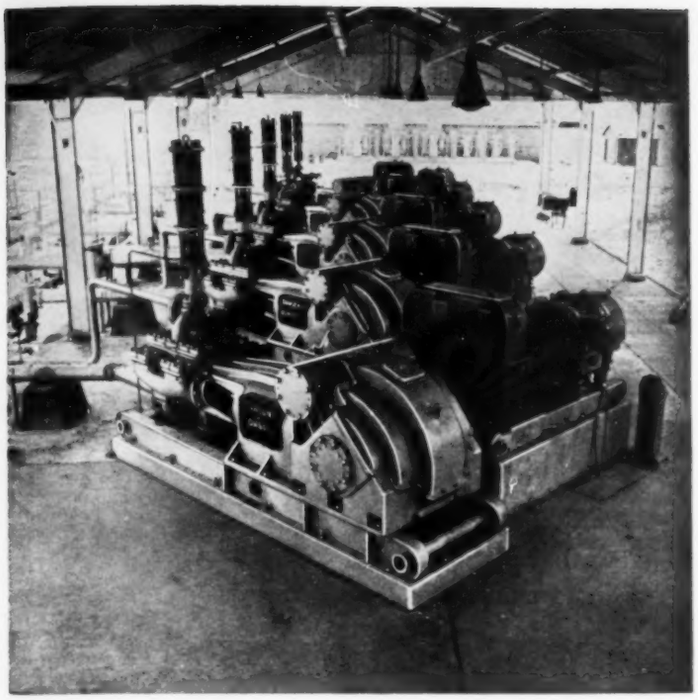
Illustrated is a series of pumps supplied to the British Petroleum Company's Oil Refinery at Aden for pumping diesel and fuel oils from the refinery to the B. P. International Oil Bunkering installation.



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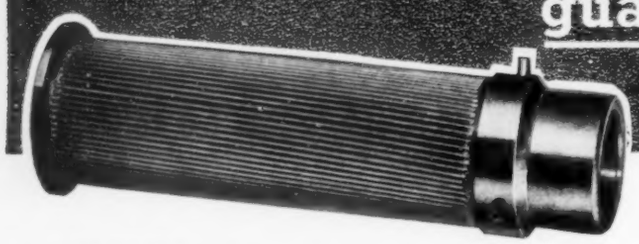

POROLOY CM.

Vokes now introduce a new all metal filter medium of outstanding efficiency for the *controlled* filtration of hydraulic and lubricating oils, fuels, air, gases, acids, caustics and related caustic materials, chemicals and solvents at extreme temperatures and pressures. Poroloy CM filter elements can be made in any size or shape from a variety of metals—Stainless Steel, Inconel, Nickel, Copper, Steel and Nichrome being the most popular—features which, combined with special production techniques to give controlled pore configuration, enable filters to be individually designed for special applications. Metals can be selected with the particular requirements of the application in mind and the size of the pores can be controlled to deal with particles of between 2 and 250 microns. Poroloy CM filters are therefore 100% effective against a stated particle size, *the danger of media migration being eliminated by an accurately controlled sintering process.* The ultimate tensile strength of the elements varies from 2,000 to 60,000 p.s.i. and the operating temperature range is from —400°F to 1200°F.

The unique combination of properties found in Poroloy CM has led to its recent use in critical temperature conditions in the United States missile and aircraft industries, including installation in the Boeing 707.

POROLOY T.

Similar in performance to Poroloy CM but manufactured by a different process, Poroloy T has an operating temperature range from —400°F to 1500°F. Pore size ratings are from 2 to 250 microns and tensile strength varies from 2,000 to 100,000 p.s.i.

This illustration shows the many sizes and forms—seamless tubes, flat discs, corrugated elements etc.—in which Poroloy can be manufactured.

Both filter elements are manufactured in conditions of micro-cleanliness and before despatch are individually checked for performance in bubble point testing equipment.

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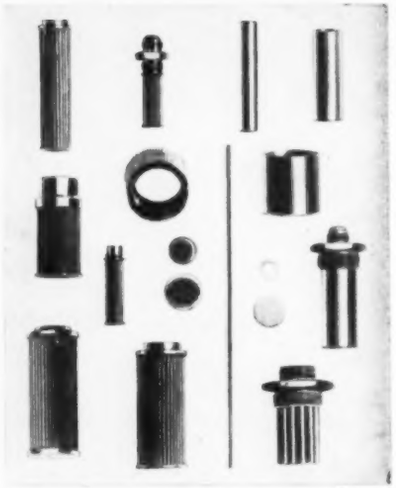

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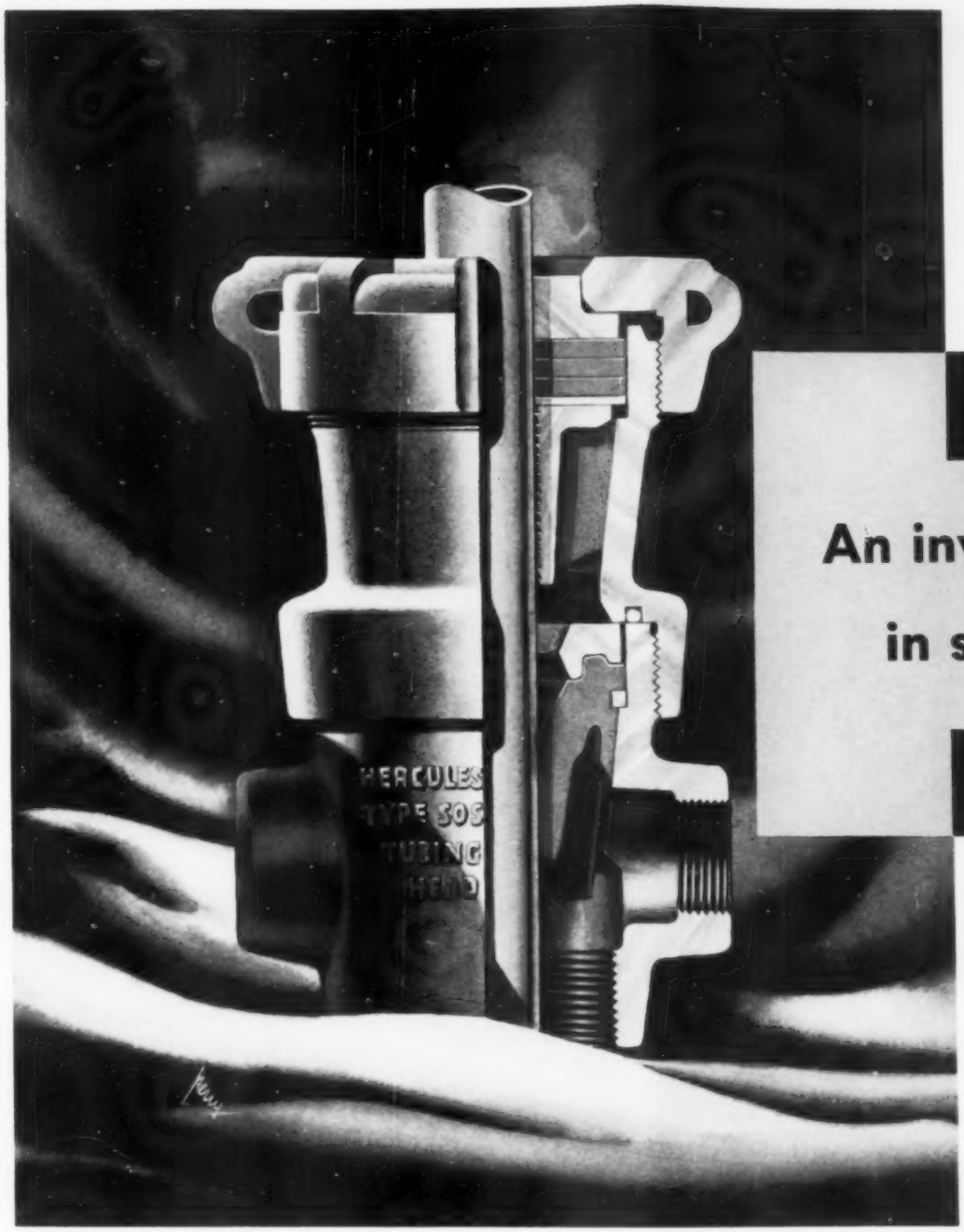

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INTERNATIONAL NEWS AND NOTES

AUSTRALIA—Texaco Overseas Petroleum Co. has reconsidered its decision to withdraw and will now remain in WAPET, the Western Australian venture, as a partner. Consequently, the respective interests will remain Texaco Overseas Petroleum Co. 2/7ths. California Asiatic Oil Co. (a subsidiary of Standard Oil Co. of California) 2/7ths, Shell Development (Australia) Pty. Ltd. 2/7ths, and Ampol Exploration Ltd. 1/7th. This reversion to the original distribution of interests will not alter West Australian Petroleum Pty. Ltd.'s exploration plans for 1961 announced earlier this year.

BOLIVIA—Gulf Oil Corp. has completed two producers in a new, shallow pay on the Caranda structure near Santa Cruz. Caranda-3A was completed from perforations between 3,410 ft and 3,488 ft and Caranda-4 from 3,573 to 3,593 ft. Both wells flowed at rates of better than 1,000 b/d of clean 52 gravity oil on test and one-half inch choke. Production is from the petaca formation of tertiary age.

INDONESIA—Just before his departure for the Belgrade conference of uncommitted (neutral) nations allied neither with East nor West, Indonesian President Sukarno announced oil profits henceforth are to be split 60% to Indonesian government, 40% to the foreign companies involved. Up to 1960, Indonesia and the companies split profits about 50-50. At the same time, Sukarno decreed the three major foreign oil companies in the country must begin operating immediately as contractors to the government. Involved are subsidiaries of Texaco and Standard of California, and of Jersey Standard and Socony Mobil. Also affected is Shell Indonesia (owned by Dutch, British, Canadian, and USA interests).

IRAN—The figure of $360 million "expected annual oil revenues" in 1961, referred to previously in WORLD PETROLEUM, is an estimate arrived by adding together the $285 million in actual government revenues from the oil consortium's operations in 1960 and the equivalent of $68 million in foreign exchange brought into the country for carrying on the consortium's activities during the same period—plus an estimated increase in both figures for 1961.

IRAQ—Crude output in the first half of this year came to 23,177,918 long tons. Iraq Petroleum Co. accounted for 17,927,972 tons; Basra Petroleum Co. for 4,608,913; and Mosul Petroleum Co. for 641,033 tons. In first half of 1960, output was 22,550,097 tons.

ITALY—Italy has not been persuaded to restrict imports of Soviet-bloc crude to Italian domestic needs, as proposed by her five Common Market partners. The move had been proposed as a means of avoiding the embarrassment of C. M. member countries having to place a ban against shipments of cut-rate gasoline refined in Italian plants such as have been going to Germany and Benelux countries. Such cut-rate product imports from Italy by other C. M. member countries have been regarded as counter to Common Market treaty.

JAPAN: The Japanese-owned Arabian Oil Co. has reached agreement with Japan's Petroleum Assn. whereby price of Arabian Oil's Persian Gulf Khafji crude will be set at a 12¢ discount to buyers in Japan because of difficulty which had prevailed in obtaining purchasers at the full posted price in a heavily discounted market. $1.30 per bbl for 26-gravity Khafji crude is 12¢ below the $1.42 posted by Arabian Oil for crude from its Neutral Zone concession offshore Saudi Arabia and Kuwait. Khafjo crude deliveries started earlier this year, and Arabian Oil expects them to average 30,000 b/d for the fiscal year which began last April.

KUWAIT—Kuwait Oil Co. will install a 30-mile crude oil line between its Minagish field and the Ahmadi tank farms constructed in equal lengths of 22, 24 and 26-in. diameters. It will operate at first on gravity flow at a little under 100,000 b/d but capacity can be increased if necessary by installing gas expansion turbine driven centrifugal pumps. Pipe is being supplied by South Durham Steel & Iron Co. Ltd., who secured the order in competitive bidding. Construction work is due to start next winter, with operation due by May 1962.

LIBYA—DEA, of Hamburg, Germany, has arranged to buy one million tons of crude oil a year from Continental Oil Co.'s Libyan production, it is reported. Conoco participates with Ohio Oil Co. and Amerada Petroleum Co. in the Oasis Oil Co. of Libya. The crude oil may come from Oasis' Concession 59 by way of the Esso pipeline, now nearly complete to Marsa Brega. Or, it may come from Oasis' Dahra oil field, by oil pipe line to Es Sidra to be completed next year.

LIBYA—The welding of Esso Standard Libya's 172-kilometer crude-oil pipeline was completed on August 8, 1961, when the last joint of 30-in.-diameter pipe was installed at Zelten. Shortly thereafter a valve was opened and the pipe-filling operation began. Esso Libya pointed out the pipeline operations are still in the experimental stage. Temporary facilities for removing dangerous sour gas from the crude are being used, since the permanent Zelten production equipment has not been completely assembled. At present, about 25,000 b/d of crude, the top capacity of facilities, are going in to fill the line.

LIBYA—Atlantic Refining and Phillips Petroleum plan a joint exploration venture on concessions granted to Atlantic in Libya during 1960. Libyan Petroleum Commission has approved assignment to Phillips of one-half interest in the concessions covering 6,700,000 acres offshore in the Gulf of Sirte. Atlantic has been conducting geological and marine geophysical studies of the site for almost a year. Drilling is expected to begin in 1962.

NETHERLANDS—NV Nederlandse Aardolie Mij., jointly owned by Bataafse Petroleum Mij (Royal Dutch/Shell) and Jersey Standard, has started exploratory drilling on a site about 2½ miles offshore near Kijkduin in south Holland. The Tyne-built platform Triton is being used, which weighs 2,400 tons and is 138 ft long and 69 ft wide. It is expected to go down to about 6,500 ft.

NICARAGUA—Standard Oil Co. (Calif.) has been authorized to market Chevron products in Nicaragua. The action represents several years of work by the company. Company officials expect to have retail outlets operating within a year.

NIGERIA — Exports of Nigerian crude oil have reached an average of 20,000 b/d and may be increased to 60,000 b/d by the end of 1961.

PAKISTAN — The prospecting license granted to Houston oil man N. B. Hunt in May of 1958 has been surrendered. License covered one square mile in Dadu district of Hyderabad Division. The one-year exploration license No. 34 granted in May 1961 to Tidewater Oil and covering about 2,525 square miles in Makran district of Kalat Division, has been renewed for another year.

QATAR—Qatar Petroleum Co. reports it exported 4,044,424 long tons of crude from Umm Said during first half of 1961. During 1960 company says it drilled total 14,344 ft at Umm Said; and that 345 tankers called at Umm Said during year.

SOMALIA — Frobisher Ltd. has granted Gulf Oil Corp. the right, exercisable by December 31, 1961, to acquire Frobisher's interest in about 37 million acres held under concession in the Republic of Somalia, East Africa. Gulf will pay US $200,000 on date the government of Somalia approves the assignment to Gulf Oil or its subsidiary on satisfactory terms. In addition, Gulf will pay Frobisher another $65,000 from the sale of oil from the concession.

SYRIA (UAR)—The Italian firm Technit has started construction on a $7 million, 20,000 b/d, 316-mile, 6-inch products line linking Syria's Homs refinery with Aleppo, Damascus, and Latakia. Line should go on-stream in about 16 months.

SYRIA (UAR)—Jezirah Oil Co. is a new firm to develop the Qarah Shuk oil fields. Of the capital of 60 million Syrian pounds, the Syrian Region Economic Foundation will hold 70% of outstanding shares; remainder to be offered to public shareholders with 5% profit guaranteed. Nominal share value is LS 25. Syrian Ministry of Interior is studying bids for construction of a 16-in. 700-kilometer crude line from Qarah Shu fields to Mediterranean—with six pumping stations and eight storage tanks of 10,000 metric tons at Tartous.

SYRIA (UAR)—UAR president Gamal Abdul Nasser announced in Cairo recently that Syria—which joined with Egypt to form the United Arab Republic—has been merged under one unified cabinet which henceforth will govern in place of the three cabinets which formerly governed the whole of the UAR and the Egyptian and Syrian regions.

TRUCIAL COAST—The French government's CFP (Cie. Francaise des Petroles) has estimated at 500 mil-

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lion tons (about 3.5 billion bbls) the combined recoverable oil reserves from the Umm Shaif offshore and Murban onshore oil fields now being developed in the Abu Dhabi sheikdom on the Trucial Coast, along the southern side of the Persian Gulf. CFP will share 23¾% in Murban output and one-third in Umm Shaif. Its combined production from the two fields should total between four and five million ton/yr, or about 80,000 b/d to 100,000 b/d. British Petroleum holds two-thirds interest in Umm Shaif.

TUNISIA—French officials in Paris state about $12 million in oil revenue has been lost in the month since Tunisia closed the pipeline from France's Edjele oil field in the Sahara. Tunisia lost $2 million in land rental for the pipeline, which normally delivers more than 750,000 tons per month to the port of La Skirra.

TURKEY — Government firm, Turkish Petroleum Corp., has found oil in Magrip No. 1 wildcat. Spudded in January 1961 in southeastern Turkey, about eight miles from nearest production and some 30 miles from TPC's Batman refinery, the well has tested 535 b/d of 20.9-gravity crude between 5,600 ft and 5,873 ft. Well went to 6,348 ft. Magrip No. 2 has been completed about not yet tested. No. 3 was drilling ahead in August.

USSR—The number of super deep wells of from 4,500 meters to 5,000 meters (14,764 ft-16,405 ft) either drilling or producing on Apsheron Peninsula (Azerbaidzhan) has risen to 100. Most of them are concentrated in the Neftyanye Kamni and Gryaznaya Sopka fields. By 1961, the delimiting of both fields is to be completed. Other oil and gas fields that have been taken in production during the last few years in Azerbaidzhan are those of Karadag, Syrya, Banka Darvina, Kyrovdag, Mishovdag, Karabagly, Sagly-Syva, Amirkhanly, and, on islands, Pyestshanyy and Duvannyy.

VENEZUELA—Venezuela crude production—which in the first half of 1961 amounted to 2,913,800 b/d—represents a gain of 64,600 b/d (or 2.3%) over same 1960 period. Gains were 70,200 b/d by Creole; 42,400 b/d by Superior; 21,500 b/d by Richmond; and 15,900 b/d by Sun. Decreases were shown by Mene Grande (down 31,600 b/d); Shell (down 20,500 b/d); Mobil (down 12,300 b/d); San Jacinto (down 10,700 b/d); and Phillips (down 10,300 b/d).

VENEZUELA—Mobil International Oil Co., on its 11,416-acre farmout from Creole, has brought in a producer—its second well on the acreage. MOB 349.1 tested, from the C-1 Eocene section, 3,860 b/d of 31.2-gravity crude through a ¾-in. choke. The well, bottomed at 12,090 ft in the Guasare formation, is located about ¾ mile south-southwest of a capped producer drilled by Creole.

VENEZUELA—Harry A. Jarvis, president of Creole Petroleum Corp., has announced the company has decided to form a subsidiary to make investments in Venezuela unrelated to the petroleum industry. These investments would be carried out, Mr. Jarvis explained, in collaboration with private Venezuelan capital. He added that Creole has been studying for some time how it could further aid in the industrialization of the country and in the promotion of economic recovery. One of the principal problems in achieving these objectives is, as is well known, the shortage of investment capital. It is with the aim of assisting in meeting this problem, Mr. Jarvis said, that Creole's board has decided to allocate $10 million to form a company which, in association with private Venezuelan capital, will participate in the financing of projects needed in broad fields of activities, including livestock and agriculture.

YUGOSLAVIA's current 5-year plan (1961-1965) provides for considerable increases in all fields of the petroleum industry. Crude reserves are presently estimated at 27 million tons, this is chiefly due to the discovery of new deposits at Struzec and Boku in 1958, Ferdinandovac, Pitomaca, Elemir, Konak, and Kikinda in 1959, and Lipovljana in 1960. Crude production is to rise from 941,121 tons in 1960 to 2.2 million tons in 1965.

Gas reserves are estimated at 10 billion cubic meters (35.31 billion cubic feet). Planned yield in 1965 is 400-600 million cubic meters (14.1-21.2 billion cubic feet), against 55 million cubic meters (1.94 billion cubic feet) in 1960.

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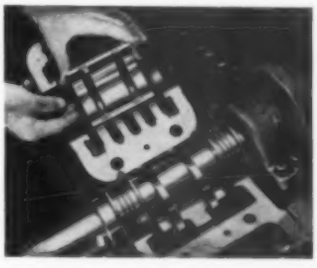

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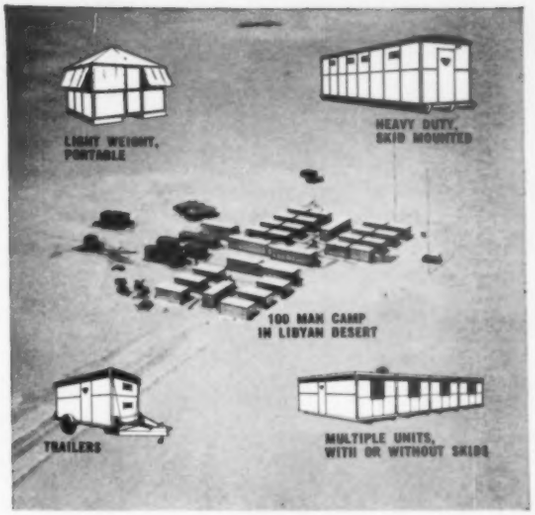
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Axelson-Garrett, Div. of U. S. Industries, Inc. 68
Glenn Mason, Cunningham & Associates

W. G. Ragnall Ltd. 4
John Haddon & Co., Ltd.

Borsig AG. 59

Bridgestone Tire Company Ltd. 24
Hakuhodo Incorporated

British Ermeto Corporation Ltd. 75
A. T. A. Advertising, Ltd.

The British Petroleum Company Ltd. 49
S. H. Benson Ltd.

Peter Brotherhood Ltd. 14
J. Peers & Associates Ltd.

The David Brown Corporation Ltd. 70
Oelrichs Advertising Ltd.

Buckingham Livery 85
Daniel & Charles, Inc.

O. R. Burden Construction Corp. 66
Keefe Advertising Agency

California Texas Oil Company 13
Gaynor & Ducas, Inc.

Cameron Iron Works Inc. Cover II
Boone & Cummings

Cape Insulation and Asbestos Products Ltd. 6-7
Taylor Advertising Ltd.

Carrier International Ltd. 83
N. W. Ayer & Son, Inc.

Cities Service Oil Company 55
Lennen & Newell Inc.

Clark Bros. Co., One of the Dresser Industries 11
Persons Advertising, Inc.

Crose Perrault Equipment Corp. 86
Paul Locke Advertising, Inc.

Cummins Diesel International 8-9
Gotham-Vladimir Advertising, Inc.

Daimler-Benz AG. 57
Heumann Werbegesellschaft M.B.H.

Davey, Paxman & Co., Ltd. 72
Industrial Publicity Ltd.

Dawson & Downie Ltd. 80
James Jack Advertising Ltd.

Dryden-East Hotel 82
Daniel & Charles, Inc.

E. I. du Pont de Nemours & Co., Inc. 51
The Rumrill Company, Inc.

The English Electric Company Ltd. 23
The Technical Advertising Service Ltd.

Ethyl Corporation 1
Reach, McClinton & Company, Inc.

Gardner-Denver Company 28-30
Glenn Mason, Cunningham & Associates

The Geolograph Company 4
Lowe Runkle Company

Goodyear International Corporation 17-20
McCann-Erickson Corporation

Grove Valve & Regulator Company 21
L. C. Cole Company, Inc.

Gulf Oil Corporation 32-33
Young & Rubicam, Inc.

Matthew Hall & Co. Ltd. 27

Halliburton Company 34
Glenn Advertising, Inc.

Frederic R. Harris Inc. 66

Hercules Tool Company 81
Keefe Advertising Agency

International Harvester Export Company 67
McCann-Erickson Corporation

Ketjen N.V. 25
Raedt en Baet

The Lummus Company 2, 5
G. M. Basford Company

McCullough Tool Company 61
Raymond O. Perry, Advertising

Metaducts Limited 77
J. Peers & Associates Ltd.

Mission Manufacturing Company 79
Rives, Dyke & Company

Motherwell Bridge Contracting And Trading Company, Ltd. 74

Newman, Hender & Co., Ltd. 63
Hamill Toms Ltd.

The North British Rubber Company Ltd. 69
The Robert Freeman Co., Ltd.

Northland Camps, Inc. 85
Nattall & Maloney Ltd.

Oil Center Tool Company Cover IV
Rives, Dyke & Company

Perkins Engines Limited 73
Crane Advertising Ltd.

Phoenix-Rheinrohr AG. Cover III
Ruhr Studio

Pick Congress Hotel 78

Porta-Kamp Manufacturing Co., Inc. 85
Troxell & Associates, Advertising

Procon, Inc. 65
Tobias, O'Neil & Gallay, Inc.

Socony Mobil Oil Company, Inc. 26
Abril Lamarque Advertising

Standard Oil Company of New Jersey 22
McCann-Erickson, Inc.

Sumitomo Metal Industries, Ltd. 71
Dentsu Advertising

Friedrich Uhde GMBH. 15

Universal Oil Products Company 52-53
Tobias, O'Neil & Gallay, Inc.

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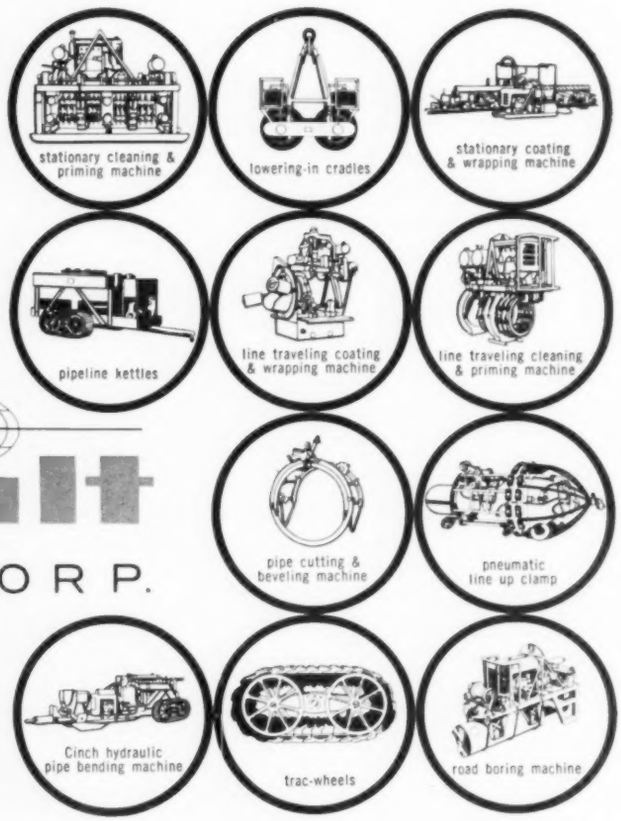
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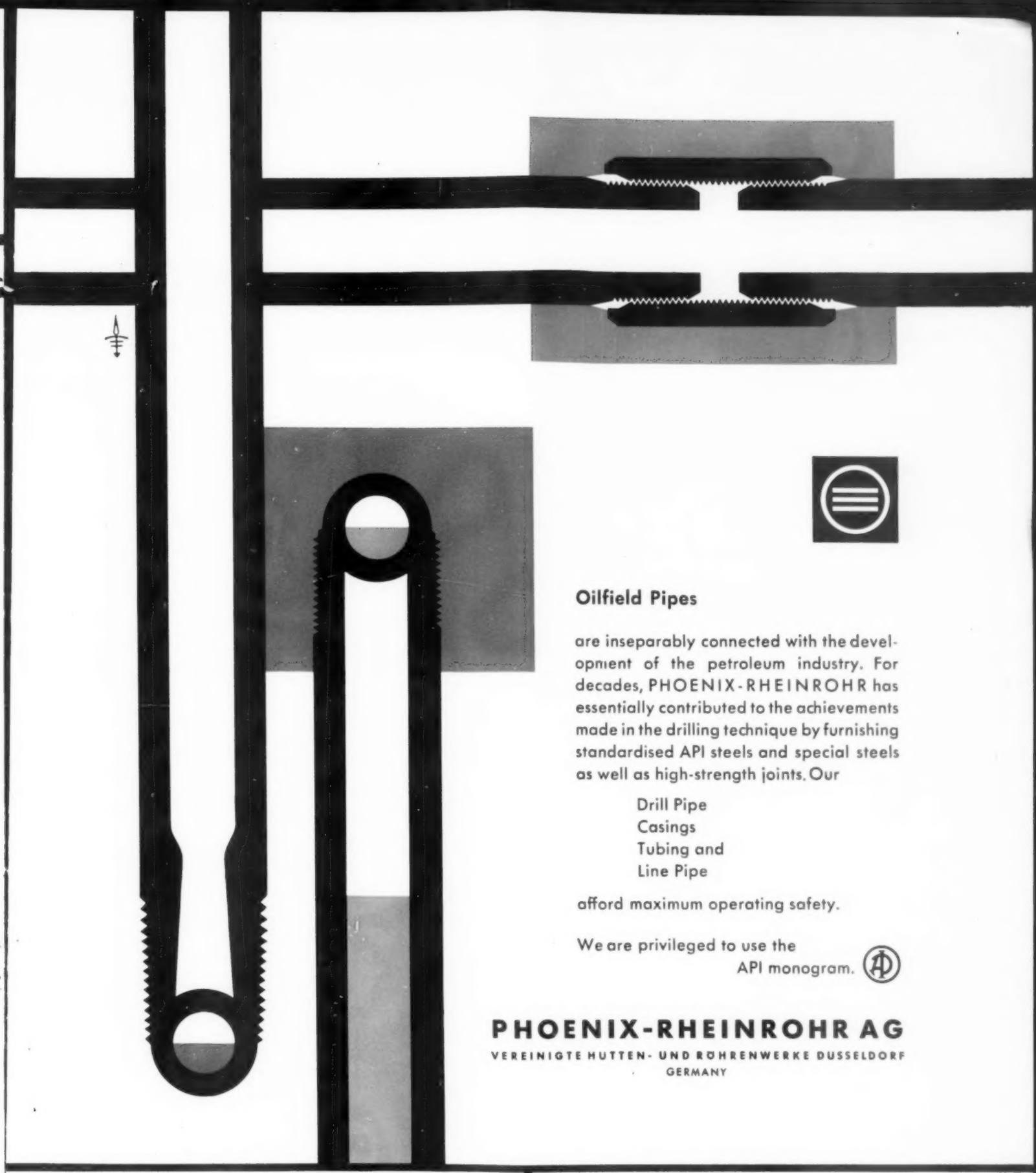

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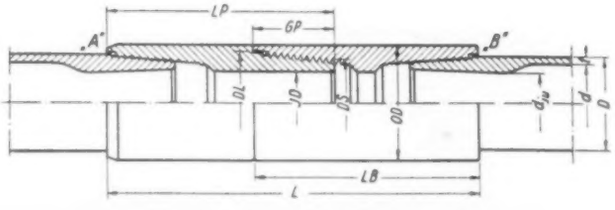

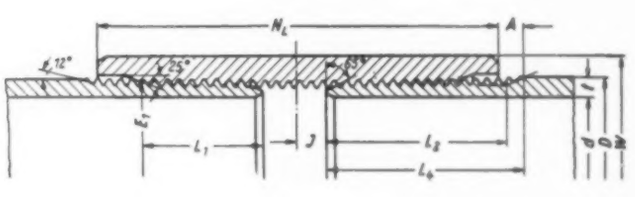

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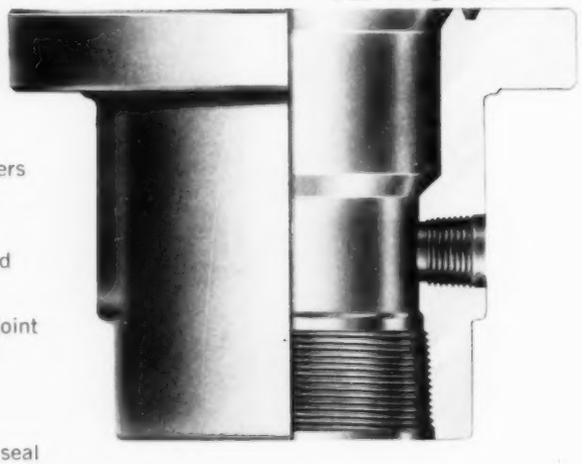

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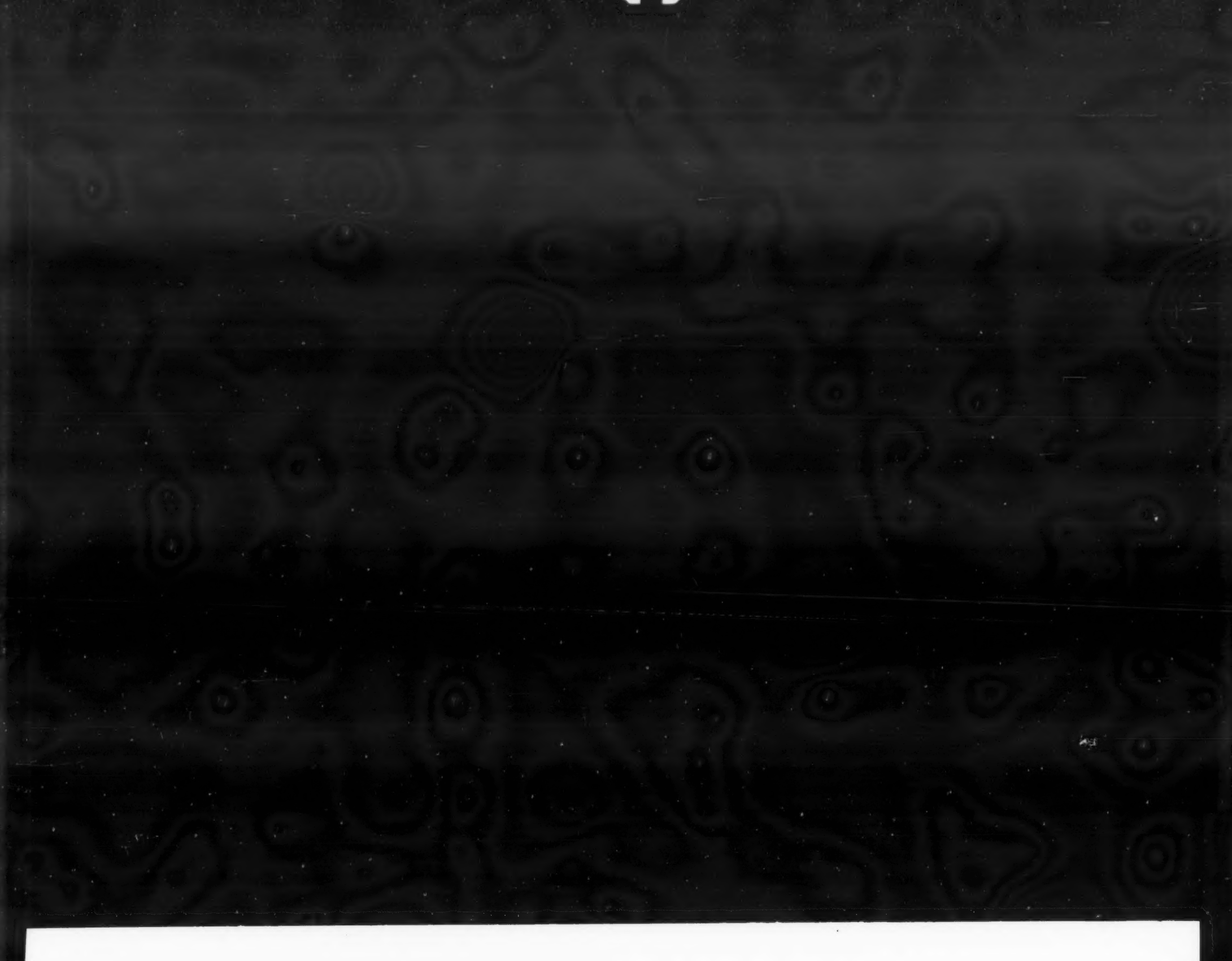
Address Export Inquiries for All Countries to P. O. Box 3091, Houston, Texas